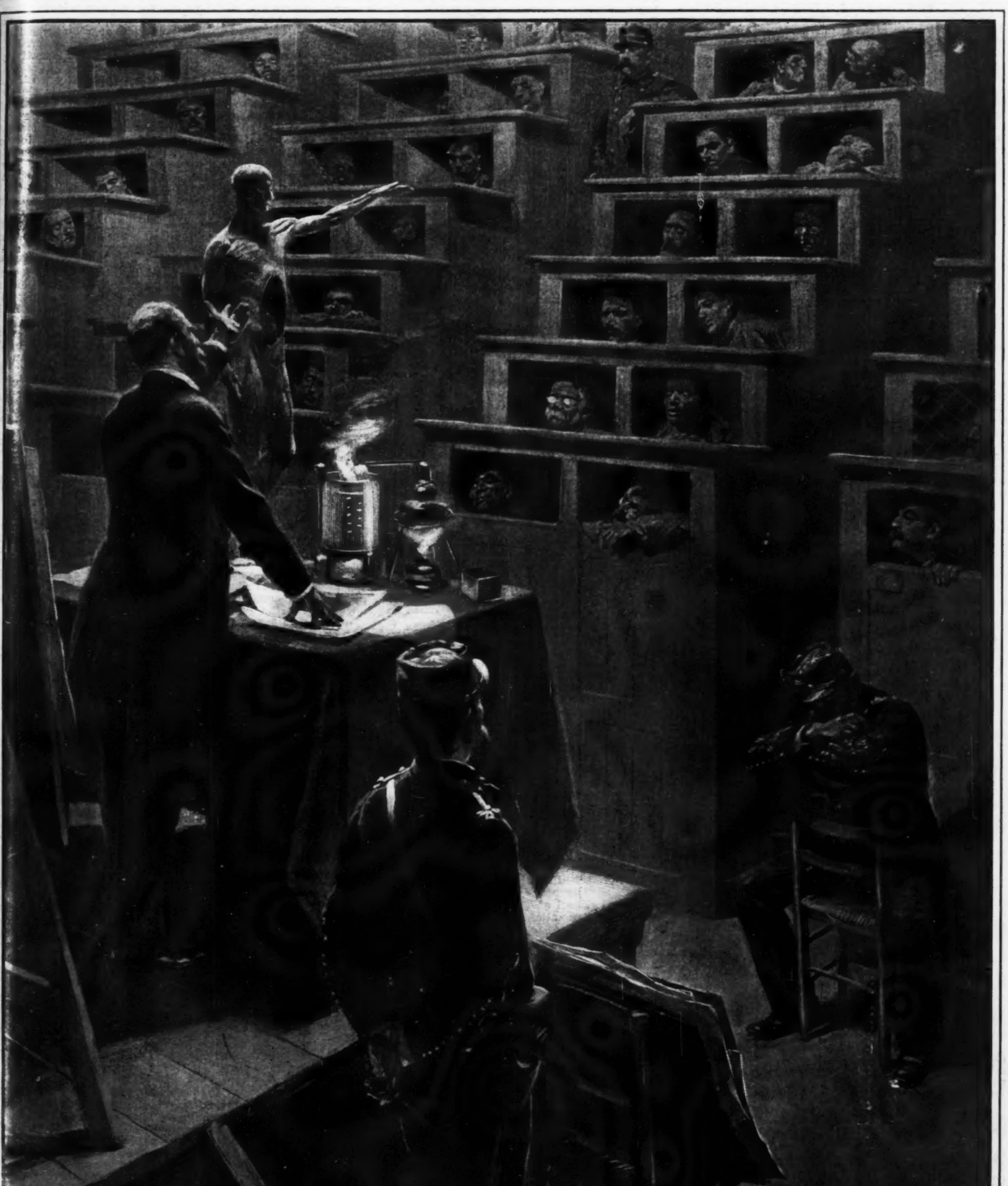
SCIENTIFIC AMERICAN SUPPLEMENT. No. 1449

Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1903, by Munn & Co.

Scientific American, established 1845.
Scientific American Supplement, Vol. LVI. No. 1449.

NEW YORK, OCTOBER 10, 1903.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



Drawn by A. Castaigne.

A CRIMINAL SANATORIUM IN FRANCE: AN ANTI-ALCOHOL LECTURE.

A CRIMINAL SANATORIUM.

The new French penitentiary at Fresnes, situated about eight miles from Paris, is the largest prison in the world, the five huge rectangular blocks, together with the gardens and warders' quarters, covering well over half a square mile, and containing accommodation for two thousand criminals. Situated in a healthy district, with large windows admitting freely the fresh air and sunshine, provided with hot and shower baths, and every one of its two thousand spacious cells lit by electricity, it presents as great a contrast to the old order of things as can well be imagined.

No less different from ancient usage is the treatment of the prisoners. Their food is wholesome and abundant; they go to "school;" they are allowed to work at trades and to purchase any luxuries but tobacco with the money thus earned; and everything possible is done to develop their better instincts. There is in Paris a "Society for Lecturing in Prisons," which frequently sends lecturers to address the prisoners, the evils of drunkenness being a favorite topic. Such a lecture forms the subject of our artist's drawing.

The lectures are given in an immense hall, on one side of which, reaching almost to the roof, are what look like steps, but on closer inspection prove to be rows of boxes with openings about four inches high, through which can be seen the heads of the audience. In this strange manner the prisoners are enabled to see the lecturer, but prevented from holding any communication with one another. Mutual recognition on release is thus also rendered impossible. These lectures against drunkenness are believed to have had some influence on the diminution of crime, which has lately been marked in France, and in future they are to be given more frequently and in a larger number of prisons. Whatever may be the effect of the system now being tried at Fresnes, it has been hailed with delight by the Parisian jail-bird, and to have been at Fresnes confers a certain dignity upon a criminal, who is not a little proud of acquaintance with this, the latest "fashionable resort" of his profession.—The Graphic.

[Concluded from Supplement No. 1448, page 23207.]

THE INFLUENCE OF BRAIN-POWER ON HISTORY.*

Sir Norman Lockyer's Presidential Address to the British Association.

The nation slowly woke up to find that its enormous commerce was no longer insured at sea, that in relation to foreign navies our own had been suffered to dwindle to such an extent that it was no longer capable of doing the duty which the nation expected of it, even in times of peace. At first this revelation was received with a shrug of incredulity, and the peace-at-any-price party denied that anything was needed; but a great teacher arose;† as the facts were inquired into the suspicion changed into an alarm; men of all parties saw that something must be done. Later the nation was thoroughly aroused, and, with a universal agreement, the principle was laid down that, cost what it might to enforce our sea-power, our navy must be made and maintained of a strength greater than those of any two possibly contending powers. After establishing this principle, the next thing to do was to give effect to it. What did the nation do after full discussion and inquiry? A bill was brought in in 1888, and a sum of £21,500,000 was voted in order, during the next five years, to inaugurate a large shipbuilding programme, so that Britain and Britain's commerce might be guarded on the high seas in any event. Since then we have spent £120,000,000 on new ships, and this year we spend still more millions on still more new ships. If these prove insufficient to safeguard our sea power, there is no doubt that the nation will increase them, and I have not heard that anybody has suggested an appeal to private effort.

How, then, do we stand with regard to universities, recognizing them as the chief producers of brain-power, and, therefore, the equivalents of battleships in relation to sea-power? Do their numbers come up to the standard established by the Admiralty principle to which I have referred? Let us attempt to get a rough-and-ready estimate of our educational position by counting universities as the Admiralty counts battleships. I say rough-and-ready because we have other helps to greater brain-power to consider besides universities, as the Admiralty has other ships to consider besides ironclads.

In the first place, let us inquire if they are equal in number to those of any two nations commercially competing with us. In the United Kingdom we had until quite recently 13.‡ Of these, one is only three years old as a teaching university, and another is still merely an examining board. In Germany there are 22 universities; in France, under recent legislation, 15; in Italy, 21. It is difficult to give the number in the United States, because it is clear, from the tables given in the report of the Commissioner of Education, that some colleges are more important than some universities, and both give the degree of Ph.D. But of universities in title we have 134. Among these there are 46 with more than 50 professors and instructors, and 13 with more than 150. I will take that figure.

Suppose we consider the United States and Germany, our chief commercial competitors, and apply the Admiralty principle. We should require, allowing for population, eight additional universities at the very lowest estimate. We see, then, that instead of having universities equaling in number those of two of our chief competitors together, they are by no means equal to those of either of them singly.

After this statement of facts anyone who has belief in the importance of higher education will have no difficulty in understanding the origin of the present condition of British industry and its constant decline, first in one direction and then in another, since the tremendous efforts made in the United States and Germany began to take effect. If, indeed, there be anything wrong about the comparison, the error can only arise from one of two sources—either the Admiralty is thoughtlessly and wastefully spending money, or there is no connection whatever between the higher intelligence and the prosperity of a nation. If while we spend so freely to maintain our sea-power our export of manufactured articles is relatively reduced because our competitors beat us in the markets of the world, what is the end of the vista thus opened up to us? A navy growing stronger every year and requiring larger votes to guard our commerce and communications, and a vanishing quantity of commerce to guard—a reduced national income to meet an increasing taxation? The pity is that our government has considered sea-power alone; that while so completely guarding our commerce it has given no thought to one of the main conditions on which its production and increase depend. A glance could have shown that other countries were building universities even faster than they were building battleships—were, in fact, considering brain-power first and sea-power afterward.

The comparison shows that we want eight new universities, some of which, of course, will be colleges promoted to university rank and fitted to carry on university work. Three of them are already named: Manchester, Liverpool, Leeds. Let us take this number and deal with it on the battleship condition, although a modern university on American or German models will cost more to build than a battleship. If our present university shortage be dealt with on battleship conditions, to correct it we should expend at least £8,000,000 for new construction, and for the pay-sheet we have to provide (8 × £50,000) £400,000 yearly for personnel and upkeep; for it is of no use to build either ships or universities without manning them. Let us say, roughly, capitalizing the yearly payment at 2½ per cent, £24,000,000.

At this stage it is important to inquire whether this sum, arrived at by analogy merely, has any relation to our real university needs. I have spent a year in making inquiries, as full as I could make them, of friends conversant with the real present needs of each of the universities, old and new. I have obtained statistics which would fill a volume, and, personally, I believe that this sum at least is required to bring our university system up to anything like the level which is insisted upon both in the United States and in Germany. Even Oxford, our oldest university, will still continue to be a mere bundle of colleges unless three millions are provided to enable the university, properly so called, to take her place among her sisters of the modern world; and Sir Oliver Lodge, the principal of our very youngest university, Birmingham, has shown in detail how five millions can be usefully and properly applied in that one locality to utilize for the good of the nation the enthusiasm and scientific capacity which are only waiting for adequate opportunity of development.

How is this money to be raised? I reply, without hesitation, duplicate the Navy Bill of 1888-9; do at once for brain-power what we so successfully did then for sea-power.

Let £24,000,000 be set apart from one asset, our national wealth, to increase the other, brain-power. Let it be assigned and borrowed as it is wanted; there will be a capital sum for new buildings to be erected in the next five or ten years, the interest of the remainder to go toward increased annual endowments. There need be no difficulty about allocating money to the various institutions. Let each university make up its mind as to which rank of the German universities it wishes to emulate. When this claim has been agreed to, the sums necessary to provide the buildings and teaching staff of that class of university should be granted without demur. It is the case of battleships over again, and money need not be spent more freely in one case than in the other.

Let me at once say that this sum is not to be regarded as practically gone when spent, as in the case of a short-lived ironclad. It is a loan which will bear a high rate of interest. This is not my opinion merely; it is the opinion of those concerned in great industrial enterprises and fully alive to the origin and effects of the present condition of things. I have been careful to point out that the statement that our industries are suffering from our relative neglect of science does not rest on my authority. But if this be true, then if our annual production is less by only two millions than it might have been, having two millions less to divide would be equivalent to our having forty or fifty millions less capital than we should have had if we had been more scientific.

Sir John Bruner, in a speech connected with the Liverpool School of Tropical Medicine, stated recently that if we as a nation were now to borrow ten millions of money in order to help science by putting up buildings and endowing professors, we should get the money back in the course of a generation a hundredfold. He added that there was no better investment for a business man than the encouragement of science, and that every penny he possessed had come from the application of science to commerce. According to Sir Robert Giffen, the United Kingdom as a going concern was in 1901 worth £16,000,000,000. Were we to put aside £24,000,000 for gradually organizing, building and endowing new universities, and making the existing ones more efficient, we should still be worth £15,976,000,000—a property well worth defending by all the means, and chief among these brain-power, we can command.

If it be held that this, or anything like it, is too great a price to pay for correcting past carelessness or stupidity, the reply is that the £120,000,000 recently spent on the navy, a sum five times greater, has been spent to correct a sleepy blunder, not one whit more inimical to the future welfare of our country than that which has brought about our present educational position. We had not sufficiently recognized what other nations had done in the way of shipbuilding, just as until now we have not recognized what they have been doing in university building. Further, I am told that the sum of £24,000,000 is less than half the amount by which Germany is yearly enriched by having improved upon our chemical industries, owing to our lack of scientific training. Many other industries have been attacked in the same way since; but taking this one instance alone, if we had spent this money 50 years ago, when the Prince Consort first called attention to our backwardness, the nation would now be much richer than it is, and would have much less to fear from competition.

When dealing with our universities I referred to the importance of research, as it is now generally acknowledged to be the most powerful engine of education that we possess. It is imagined by many who have given no thought to the matter that this research should be closely allied with some application of science being utilized at the time. Nothing could be further from the truth; nothing could be more unwise than such a limitation. Surely all the laws of Nature will be ultimately of service, and, therefore, there is much more future help to be got from a study of the unknown and the unused than we can hope to obtain by continuing the study of that which is pretty well known and utilized already. It was a king of France, Louis XIV., who first commended the study of the *meme inutile*. The history of modern science shows us more and more as the years roll on the necessity and advantage of such studies, and, therefore, the importance of properly endowing them; for the production of new knowledge is a costly and unremunerative pursuit.

Years ago we had Faraday apparently wasting his energies and time in playing with needles; electricity now fills the world. To-day men of science in all lands are studying the emanations of radium; no research could be more abstract; but who knows what advance in human thought may follow or what gigantic world-transforming superstructure may eventually be raised on the minute foundation they are laying? If we so organize our teaching forces that we can use them at all stages, from the gutter to the university, to sift out for us potential Faradays—to utilize the mental products which otherwise would be wasted—it is only by enabling such men to continue their learning after their teaching is over that we shall be able to secure the greatest advantage which any educational system can afford.

I finally come to the political importance of research. A country's research is as important in the long run as its battleships. The most eloquent teaching as to its national value we owe to Mr. Carnegie, for he has given the sum of £2,000,000 to found a system of endowments, his chief purpose being, in his own words, "to secure, if possible, for the United States of America, leadership in the domain of discovery and the utilization of new forces for the benefit of man." Here is a distinct challenge to Britain. Judging by experience in this country, in spite of the magnificent endowment of research by Mond and Lord Iveagh, the only source of possible competition in the British interest is the state, which certainly could not put the 1-8,000 part of the accumulated wealth of the country to a better use; for without such help both our universities and our battleships will become of rapidly dwindling importance. It is on this ground that I have included the importance of endowing research among the chief points to which I have been anxious to draw your attention.

In referring to the new struggle for existence among civilized communities, I pointed out that the solution of a large number of scientific problems is now daily required for the state service, and that in this and other ways the source and standard of national efficiency have been greatly changed. Much evidence bearing upon the amount of scientific knowledge required for the proper administration of the public departments, and the amount of scientific work done by and for the nation, was brought before the Royal Commission on Science presided over by the late Duke of Devonshire now more than a quarter of a century ago. The Commission unanimously recommended that the state should be aided by a scientific council in facing the new problems constantly arising.

But while the home government has apparently made up its mind to neglect the advice so seriously given, it should be a source of gratification to us all to know that the application of the resources of modern science to the economic, industrial, and agricultural development of India has for many years engaged the earnest attention of the government of that country. The Famine Commissioners of 1878 laid much stress on the institution of scientific inquiry and experiment designed to lead to the gradual increase of the food supply and to the greater stability of agricultural outturn, while the experience of recent years has indicated the increasing importance of the study of the economic products and mineral-bearing tracts. Lord Curzon has recently ordered the heads of the various scientific departments to form a board, which shall meet twice annually, to begin with, to formulate a programme and to review past work. The board is also to act as an advisory committee to the government,* providing among other matters for the proper co-ordination of all matters of scientific inquiry affecting India's welfare. Lord Curzon is to be warmly congratulated upon the step he has taken, which is certain to bring benefit to our great dependency. The importance of such a board is many times greater at home, with so many external as well as internal interests to look after—problems common to peace and war, problems requiring the help of the economic as well as of the physical sciences. It may be asked, what is done in Germany, where science is fostered and utilized far more than here? The answer is, There is such a council, I fancy, very much like what our Privy Council once was. It consists of representatives of the ministry, the universities, the industries, and agriculture. It is small consisting of about a dozen members, consultative, and it reports direct to the Emperor. It does for industrial war what military and so-called defense councils do for national armaments; it considers everything relating to the use of brain-power in peace—from alterations in school regulations and the organization of the universities to railway rates and fiscal schemes, including the adjustment of duties. I am informed that what this council advises generally becomes law.

It should be pretty obvious that a nation so provided must have enormous chances in its favor. It is a question of drilled battalions against an undisciplined army,

* Delivered at Southport September 9, 1903.—Abstract.

† Capt. Mahan, of the U. S. Navy, whose book, "On the Influence of Sea-power on History," has suggested the title of my address.

‡ These are Oxford, Cambridge, Durham, Victoria, Wales, Birmingham, London, St. Andrews, Glasgow, Aberdeen, Edinburgh, Dublin, and Royal University.

* Nature, September 4, 1903.

of the use of the scientific spirit as opposed to the hope of "muddling through."

Some may say that it is contrary to our habit to expect the government to interest itself too much or to spend money on matters relating to peace; that war dangers are the only ones to be met or to be studied. But this view leaves science and the progress of science out of the question. Every scientific advance is now, and will in the future be more and more, applied to war. It is no longer a question of an armed force with scientific corps; it is a question of an armed force scientific from top to bottom. Thank God, the navy has already found this out. Science will ultimately rule all the operations both of peace and war, and therefore the industrial and the fighting population must both have a large common ground of education. Already it is not looking too far ahead to see that in a perfect state there will be a double use of each citizen—a peace use and a war use; and the more science advances, the more the old difference between the peaceful citizen and the man at arms will disappear. The barrack, if it still exists, and the workshop will be assimilated; the land unit, like the battleship, will become a school of applied science, self-contained, in which the officers will be the efficient teachers. I do not think it is yet recognized how much the problem of national defense has thus become associated with that with which we are now chiefly concerned.

These, then, are some of the reasons which compel me to point out that a scientific council, which might be a scientific committee of the Privy Council, in dealing primarily with the national needs in times of peace, would be a source of strength to the nation.

To sum up, then. My earnest appeal to you is to gird up your loins and see to it that the science of the British Empire shall no longer remain unorganized. I have endeavored to point out to you how the nation at present suffers from the absence of a powerful, continuous, reasoned expression of scientific opinion, urging in season and out of season that we shall be armed as other nations are with efficient universities and facilities for research to uphold the flag of Britain in the domain of learning and discovery, and what they alone can bring.

I have also endeavored to show how, when this is done, the nation will still be less strong than it need be if there be not added to our many existing councils another, to secure that even during peace the benefits which a proper co-ordination of scientific effort in the nation's interest can bring shall not be neglected as they are at present. Lest some of you may think that the scientific organization which I trust you will determine to found would risk success in working on such large lines, let me remind you that in 1859, when the late Prince Consort occupied this chair, he referred to "impediments" to scientific progress, and said, "they are often such as can only be successfully dealt with by the powerful arm of the state or the long purse of the nation." If the Prince Consort had lived to continue his advocacy of science, our position to-day would have been very different. His early death was as bad for Britain as the loss of a great campaign. If we cannot make up what we have lost, matters cannot mend.

I have done what I feel to be my duty in bringing the present condition of things before you. It is now your duty, if you agree with me, to see that it be put right. You can if you will.

THEORIES OF SLEEP.

By PERCY G. STILES, University and Bellevue Hospital Medical College.

IT is not easy to define the condition of sleep in terms that will not admit of many exceptions. We readily recognize the states of rest and activity, but where the element of consciousness must be considered we are at once upon uncertain ground. If we think of sleep as an unconscious state, sharply contrasted with waking, we do well to limit our use of the word to the case of man and the most intelligent animals. Sleep in this sense is only to be associated with highly developed nervous systems and its final explanation is to be sought in events taking place in the brain.

Various writers upon the subject of sleep have turned their attention to quite different aspects of the matter. Some have undertaken to show why there is the need of sleep and why the tendency to sleep comes on at the close of each day. These writers have dealt with general or systematic causes. Others have concerned themselves with the cause of the unconscious—or dreaming—state in which the sleeper lies. They have endeavored to suggest intimate and local causes. Since the several theories are thus distinct in their application they are not necessarily mutually exclusive.

Broadly speaking, we feel sure that the need of sleep follows from general or local fatigue. During waking hours the decomposition processes of the body doubtless rise above the life-long mean, and sooner or later there must be a compensatory fall below the average. The adaptation of the race to alternating light and darkness has made this rhythmic rise and fall to coincide with day and night—though less rigidly under the artificial conditions of civilized life than in more primitive times.

Fatigue at bottom is a chemical phenomenon, and so the theories of the first class are chemical. When a muscle has been stimulated until it exhibits the well-known signs of fatigue, there are two possible inferences—either this means an exhaustion of fuel substances or an accumulation of poisonous waste. Analogous views have been supported in regard to the chemical changes that lead to sleep. We have had an exhaustion theory advanced by Pflüger and an accumulation theory offered by Preyer.

Pflüger's theory has little experimental evidence in its favor. We know that a bloodless muscle may be subjected to a vacuum and made to part with its free oxygen, but that it is still capable of doing much work and of giving off carbon dioxide. In other words, oxidation may take place in the absence of free oxygen. Of course there is but one reasonable explanation, namely, that there is a store of the element in loose chemical combination. This store in the cells is often spoken of as "intra-molecular" oxygen, and its amount may be supposed to vary between rather wide limits. Pflüger pointed out that during the day, the katabolic processes being above the average, this hoard might be reduced until the lack of it should lead to the depression of functional activity and the suspension of consciousness characteristic of sleep.

Perhaps no one will maintain that this theory is adequate by itself. If there were nothing but intra-molecular oxygen to be considered, we should expect that a day of idleness would leave one fresh and bright at bed-time and that severe exercise for half a day might make a long sleep a pressing necessity. Pflüger's idea seems to explain more readily the sensation of being *tired* than that of being *sleepy*, which is so often quite independent of the other.

The alternative theory is to the effect that the waste-products of metabolism are not fully and promptly removed as they are formed during the day's activities, but gradually clog and poison the system until torpor is induced. The lactic acid produced in muscular contractions is held responsible for a great part of this toxic process. Acidity of the blood produces coma, and whatever reduces its normal alkalinity might be expected to favor sleep. Many objections to this theory suggest themselves. It does not explain why many people are at their best late in the day, nor why the onset of sleep is relatively sudden, nor why we are sleepy in the height of digestion when the blood is most alkaline. It is perhaps less easy to assail it if we suppose that the waste-products in question are not at large in the blood but have accumulated in certain cells, especially of the nervous system. In this case we need not assume a large quantity of these narcotic poisons, but only a peculiar distribution, and we can see why mental work is quite as fatiguing as physical work.

The transition from wakefulness to sleep seems rather abrupt, but is not instantaneous. Motor control is generally lost before sensation, and most people agree that of the avenues of communication with the world without, hearing is the last to be closed. This order of events is reversed in waking, when the alarm-clock or the unwelcome call is heard for an appreciable time before the eyes can be opened or a definite sense of one's situation realized. The sinking into sleep is favored by the removal of all that may excite either the attention or the reflexes. Darkness, quiet, bodily comfort and mental serenity are therefore sought. Sleep may be prevented by any of the contrary conditions—light, noise, pain or anxiety. When it is necessary to contend against drowsiness, one instinctively seeks objects for attention or sensory stimulation, such as may be secured by taking a slightly uncomfortable position. Evidently sleep presupposes a release of the brain from many stimuli and may be warded off by seeing to it that no such release is granted. There is on record the case of an unfortunate boy who had no cutaneous sensibility, was blind in one eye and deaf in one ear. His mentality was of a low order. To cause him to sleep it was only necessary to cover the serviceable eye and ear for a few moments. Here the waking condition was clearly dependent on an unceasing flow of sensory impulses into the brain. A person of higher intelligence, similarly afflicted, would doubtless sleep much less readily, for trains of thought might keep him awake in default of external stimuli.

The approach of sleep is accompanied by distinct vascular changes. The blood stream is shifting its bed. A most imperious summons to sleep comes from the dryness of the eyes, the sign, probably, of a lessened blood-flow through the tear glands. At the same time the temperature of the skin rises, possibly excepting that of the extremities. There is evidence then of a dilatation of the cutaneous vessels as sleep comes on, and the final passage into unconsciousness is accompanied by a considerable further dilatation. These vascular changes have been nicely gaged by what is known as the plethysmographic method, where the subject lay with one hand and forearm fixed in a glass cylinder filled with water. An increase of blood in the arm displaced water from the cylinder and a delicate recording apparatus showed how this dilatation came on with sleep, and passed off with waking. An account of such experiments, of more than technical interest, is that contributed by Dr. W. H. Howell to The Journal of Experimental Medicine (Vol. II.).

It is generally inferred that the cutaneous dilatation at once reduces the general blood-pressure and the quantity of blood flowing through the brain, by diverting a large share to the skin. The lowering of pressure has been demonstrated by Brush and Fayerweather; the fact that there is anemia of the brain during sleep has been established by direct observation. An English physiologist, Hill, has been led to believe that the dilatation of blood-vessels that relieves the brain in sleep is not limited to the skin, but shared by the arteries of the digestive tract. That this is so is difficult to prove, but it is suggestive that a heavy meal is followed by a long sleep in the case of the lower animals, and often with us by a hard struggle with drowsiness.

Cerebral anemia may be merely a concomitant of sleep, but it has frequently been held to be its immediate cause, the cells having previously been fatigued and suffered a lowering of functional capacity which has made them increasingly susceptible to depressing influences. This is the basis of Howell's theory. He has suggested that the exhaustion of the vaso-motor center is what induces sleep. We know that this center is in tonic activity, sending out impulses which hold the blood-vessels in a state of constriction greater than is natural for them. This tonic activity can only mean constant metabolism in the cells of the center. Furthermore, the center is subject to the play of afferent impulses from all parts of the body. It is reflexly spurred to action by every sensory impression through eye or ear. It is called to respond in an appropriate manner to every change of posture or other muscular movement. It does not escape the effects of psychic processes, emotional states. Nothing is more natural than to suppose that the nerve cells of the center become fatigued by this unceasing activity. After the hours that we habitually number in a period of waking it responds less and less readily to the demands made upon it. It begins to lose its grip, so to speak, on the superficial and perhaps the splanchnic vessels. The blood supply to the brain tends to become less and the pressure in its arteries to be reduced. The subjective consequence is drowsiness. If it is resisted by fixing the attention or by exercise, the center rallies temporarily under the spurring, contracting the vessels and turning the tide of blood back into the brain. But the anemia soon returns, and the drowsiness becomes more compelling. When the person lies down, a flood of sensory impulses that have been pouring in from the contracting muscles is suddenly checked. The eyes are closed and the stream of visual impulses ceases. With the withdrawal of this reflex stimulation and the acquiescence of the will the center relaxes still further its hold upon the cutaneous vessels, the blood-flow in the brain becomes more reduced, and unconsciousness comes on. During sleep the vaso-motor center is responsive to stimuli from without as the plethysmographic experiments show. A sufficient stimulus produces waking, and seems to operate by turning back into the brain a sufficient quantity of blood displaced from the contracting vessels of the skin. Such a stimulus must be a strong one in the first hour or two of sleep, but later a much weaker one will answer. Several physiologists have tested the depth of sleep at different hours of the night, judging of it by the height from which a weight must be dropped that the sound of its fall shall arouse the sleeper. All have agreed that the greatest depth of sleep is reached as early as the second hour. According to one writer it becomes steadily more shallow from that time until the end. Others have observed a second, minor deepening toward morning. Many people will agree that their own sensations seem to imply such a second period of comparatively profound sleep.

What we call natural waking in the morning is usually due to some stimulus from without—light or sound—which would not have roused one from the deep sleep of midnight. But the stimulus may come from within, as from the state of certain organs or, curiously enough, from the previous resolution to wake at a certain time, which often operates with something of the compulsion of a hypnotic suggestion. Howell supposes that during sleep the nerve-cells of the vaso-motor center are gradually restored to prime condition and hour by hour become more irritable. So it is easier as time passes to induce the vascular changes that involve waking. Moreover, the recuperated center resumes something of its normal tonic activity before consciousness returns, and so the final step is taken with none of that sense of violence that accompanies a sudden waking from sound sleep. The border-line is likely to be crossed and recrossed several times before the waking state is well established. When one is fairly roused, mental activity and the pouring in of sensory impulses keep him from further napping.

Now what peculiar condition can be conceived to exist in the brain during the period of anemia and unconsciousness? What microscopical changes may be supposed to mark the transition from wakefulness to sleep? Oddly enough, the two hypotheses which are extant are quite opposite in character. The first, which has attracted the greater notice, is that of Duval. He has suggested that consciousness depends on the contact of cell-processes in the brain whereby effects are propagated from neurone to neurone. If sensory impulses are to alter consciousness, there must be a pathway for their passage. If a single synapse on the course of such a pathway is rendered impassable, the message from the sense-organ is lost from conscious life. If every sensory path is interrupted at any point between the periphery and the cortex, there must be insensibility as to the outside world and the state of the body. If all motor paths are likewise broken, there can be no voluntary action. If, in the third place, the association paths are also severed, there can be no synthetical processes of thought, no ideation. In short, the brain must lose its individuality by the breaking of connections between its structural elements. If we could suppose that every synapse in the central nervous system might be snapped, and impassable gaps opened between the cells wherever one had been wont to influence another, there must be an end of consciousness, for, in utter isolation, these cells could no longer combine their activities into one whole such as forms the physical basis of psychic life. A much more local disruption of connection, limited perhaps to the cortex, might be sufficient to explain the subjective condition in sleep. At any rate, Duval's view is that the cortical cells are capable of retracting or extending their processes so as to sever and resume their relation with neighboring elements. Experimental evidence in support of this theory is naturally slight. Wiedersheim has described amœboid movements on the part of cells in the nervous system of a small transparent crab. Of course it is only in such lower forms that the living cells can readily be brought under the microscope. Duval himself suddenly beheaded dogs that were awake and others in anæsthesia and made histological preparations from the brains. He believed he could distinguish the sleeping brain by the more contracted and isolated appearance of its cells.

The second histological theory of sleep, which has been said to be quite opposed to the first, is that of the Italian neurologist, Lugaro. Both demand the capability of amœboid movement on the part of the cells. But while Duval supposes that in sleep the cells have broken their contacts, Lugaro supposes that they have made *new contacts* with great freedom. At first thought this view seems unreasonable. A multiplicity of contacts and added pathways in the brain might be supposed to imply a richer and keener consciousness. But this would be true only to a certain point. When the indiscriminate combination had gone a step further mental confusion might be expected, then fantastic associations and a meaningless mosaic of memories—practically a state of dreaming. Let the cells commingle their impulses still more freely and consciousness will be lost, for the diffusion of energy in the brain will result in a lessened intensity of flow in the principal channels. If each cell scatters its communications in every possible direction no definite effect in consciousness is to be looked for. According to Duval, the cells which are affected in sleep can not discharge; according to Lugaro, they may do so, but

the resulting impulses are utterly dissipated in a maze of by-ways. Waking, according to Duval, is the resumption of intercourse among these cells; according to Lugaro, it is the restriction of intercourse to habitual and purposeful channels.

There is no reason why we may not be eclectic in regard to these two points of view. It may be that many paths are interrupted in sleep, while others are opened. In the hypnotic state it is clear that many paths are blocked, including those by which the will of the subject habitually asserts itself, while others, especially those making connections between the auditory and motor areas, transmit impulses with extraordinary efficiency. This condition is explicable if we suppose that certain synapses are broken, as Duval imagines, and that the tide of nervous impulses pours with intensified energy through the narrowed outlets remaining—an idea borrowed from Lugaro. If we consider that a man is most thoroughly awake when his attention is most rigidly concentrated, when he is a "man of one idea," we shall perhaps incline toward Lugaro's conception of sleep, which is certainly as far as possible removed from this mental fixedness. Hypnosis is accompanied by cerebral congestion and natural sleep by anemia. There is accordingly a strong temptation to suppose that the cell-changes in the two states are opposite in their nature, that in hypnosis the retraction of the dendrites is characteristic, and in natural sleep their extension. The sluggish condition of the mind under suggestion as compared with its fanciful flights in dreaming falls happily in line with this view. But such speculation is premature.

It was said at the outset that the several theories of sleep are not all mutually exclusive. It is possible to go beyond this statement, for we may assign a place to each of those mentioned without inconsistency. We may suppose in the first place that the alternation of day and night through the ages has impressed its rhythm upon the race, so that it is hard for the individual to break from the habitual course in which activity is associated with light and rest with darkness. In other words, the amount of the metabolism tends to keep above a mean for some hours and then to fall below it. The excess of destructive processes over those which are recuperative during the waking hours results in general and local fatigue, a condition into which may enter both the depletion of intramolecular oxygen and the accumulation of toxic waste-products. While this progressive loss of condition affects the body as a whole, the nervous system is subject to its own peculiar drains. It is very probably the hard-worked vasomotor center which proves to be the vulnerable spot. With its release of the blood-vessels in certain areas from its reinforcing influence comes the cerebral anemia. Then, we may suppose, the nerve-cells become less active than in the brain which has its full supply of blood, that they cease to send impulses over the usual routes, either because gaps have opened or because such impulses as do arise are permitted to stray and be scattered, producing no effect in consciousness or one which is quite bizarre and meaningless.

Such an outline as this is a composite scheme in which the conditions emphasized by Pflüger and Preyer are given recognition as fundamental causes of sleep, Howell's idea is accepted as explaining well its onset, its varying depth and the awakening, while the pictures sketched by Duval and Lugaro are combined to represent the intimate state of the slumbering brain.—Popular Science Monthly.

MANUFACTURE OF STAMPED ENVELOPES.*

The envelope machine used by the United States government was invented by Mr. Horace J. Wickham, of Hartford, Conn. It gums, stamps, prints, folds, and counts the envelopes. A cut of five hundred blanks is placed upon the top of the table or bed, which elevates them to the proper height for the pickers. Above the blanks is a gum box, containing rollers to take the gum and spread it on pickers, causing the top blank to separate and rise in position to be taken by the pickers, which rise and fall, thus causing the top blank to separate and rise in position for the conveyers. The latter carry the blanks forward over the die and type, where inks of the proper colors are supplied. After being stamped and printed they pass on to a box for folding, the three sides being stuck together and the fourth being left to dry. The envelope is then dropped into an endless chain from which, by means of pincers, they are pulled out from the side, one by one, the machine counting them into packages of twenty-five and depositing the same, ready for boxing. This machine was designed and especially built for government work, although it is used to quite an extent in manufacturing for the trade. A single machine, with one attendant, turns out forty-five thousand envelopes a day, thus reducing the cost of manufacture to a very low figure.

* Specially prepared for the Scientific American Supplement.

THE WICKHAM ENVELOPE MACHINE.

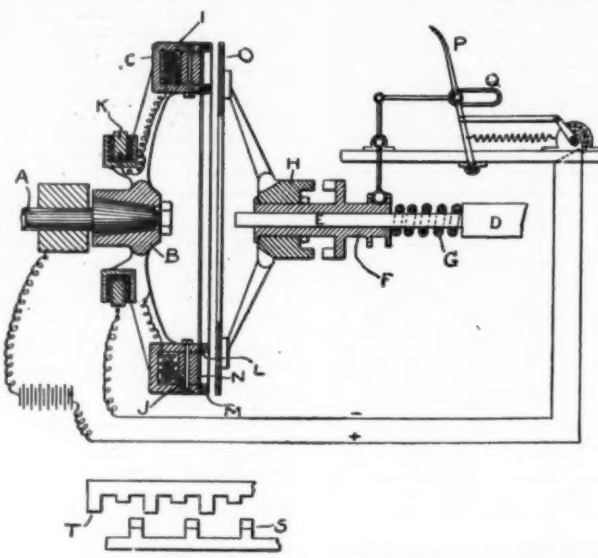
JENATZY MAGNETIC CLUTCH.

M. Camille Jenatzy, winner of the late Gordon Bennett race and previously well known as the designer of the "Jamais Contente" and other electric vehicles, is the inventor of a magnetic flywheel clutch which is successfully used on the Belgian "Pipe" cars, and which, according to report, will be fitted to the Mercedes and Mors cars next year. This clutch has lately been patented abroad and in this country, and from a comparison of the specifications the following particulars have been derived:

A is the motor shaft, *B* the flywheel hub, *C* the flywheel rim, and *D* the driven shaft. On the end *E* of *D*, which is squared, slides a sleeve, *F*, backed by a spring, *G*, and carrying loosely on it the hub, *H*, of the driven member of the clutch. The rim, *C*, is made an electro-magnet by recessing it, leaving an inner and an outer lip to form the poles, and imbedding the coil, *I*, between them. A follower ring, *J*, of non-magnetic metal is then bolted in place. One terminal of the coils is grounded on the flywheel and the other led to an insulated feeding ring, *K*, as shown.

The remaining construction of the rim portion is not wholly clear from the specifications, but apparently the two concentric rings, *L M*, are of soft iron, and are fixed by bronze screws to the rim lips, with the flat ring, *N*, interposed to prevent residual magnetism from causing the cast-iron armature, *O*, of the driven member to stick when the current is broken. Doubtless the reason for using this arrangement, instead of the more obvious and very common one of making one of the rubbing surfaces non-magnetic, is the desire to use the cheaper metal for the parts needing renewal.

In connection with the magnetic clutch is a jaw clutch connecting *H* with sleeve, *F*. This sleeve, which is shown in its rearmost position, is brought to that position by pressure on pedal, *P*, a pin on which works in the slot, *Q*. This pedal operates also a rheostat, *R*, interposed in the clutch circuit, and which is open in the releasing position shown. As the pedal moves backward, the rheostat arm closes the circuit through a resistance which is gradually cut out with further motion. On account of the slot, *Q*, this motion is not complete till after the jaw clutch has engaged *F* and *H*, and the grip of the rim clutch, with full power of the engine, is not absolute till the resistance is wholly cut out. Although the drawing does not show it, there is presumably a thrust collar or stop to limit the backward motion of *H* and ensure its disengagement from *F*.



THE JENATZY MAGNETIC FLYWHEEL CLUTCH.

The object of this jaw clutch release, which might not at first be apparent, is to relieve the gears of the shocks due to the inertia of the revolving armature, *O*, when changing speeds. In operation, the first pressure on the pedal will introduce resistance at *R* and allow the clutch to slip. When the pedal has moved the length of slot, *Q*, it begins to draw sleeve, *F*, back, and final disconnection occurs just after the magnetic circuit is broken. On releasing the pedal after a shift of gears, *F*, which is now running at a different speed from *H*, engages the latter before the rim clutch is excited. It will be noticed that alternate teeth on *H* are longer than the others, while those on *S* are of uniform length and spaced to match the long teeth on *H*, as shown in the developed plan at the foot. According to the inventor, teeth *S*, on meeting the long teeth, *T*, rub against their faces before engaging, thus softening the shock, and finally settle into engagement with the short teeth. At first sight this seems absurd, but what actually happens is probably that the teeth, having presumably rounded corners and being forced together only by the spring, *G*, instead of by hand, rebound more or less on their first impact, and receive some of the change of velocity in that way before they settle into final mesh. The object of the short teeth would then be simply to prevent "backlash" when the teeth are finally engaged.—The Automobile.

PRODUCTION OF COKE IN 1902.

The production of coke in the United States in 1902, according to the report now in press prepared by Mr. E. W. Parker for the United States Geological Survey, exceeded that of any year in our history. The product, which includes the output from retort or by-product ovens, amounted last year to 25,401,730 short tons, as compared with 21,795,883 short tons in 1901, and with 20,533,348 tons in 1900. The increase in 1902 over 1901 amounted to 3,605,847 short tons, or 16.5 per cent, and this increase would have been much larger had the transportation facilities been commensurate with the demand for coke and with the productive capacity of the ovens.

The unprecedented production of coke in 1902 was accompanied by an increase of value which was even more worthy of note. The average price per ton at the ovens was the highest recorded in a period of 23 years, and the total value reached the high figure of $63,339,167, an increase over the preceding year of $18,893,244, or 42.5 per cent. The value of the coal used in the manufacture of coke in 1902 exceeded that of 1901 by $7,922,563, from which it appears that the value of the coke product increased $10,970,681 over and above the increased value of the coal used in its production. In 1901 the highest price obained for Connellsville furnace coke was $4.25, which was paid in March and April of that year. In September and October of 1902, while contract coke was nominally quoted at $3 per ton, consumers were paying from $10 to $12 per ton for prompt delivery, and as much as $15 per ton was reported.

During 1902 there were 69,069 coke ovens in existence in the United States, as compared with 63,951 ovens in 1901. Of these 69,069 ovens, 67,124 were active and produced an average of 378.4 tons per oven. The total number in 1902 included 1,663 by-product

recovery ovens, which produced 1,403,588 tons of coke, an average of 844 tons of coke per oven.

In the order of production, Pennsylvania ranked first, with 16,497,910 short tons, an increase over 1901 of 2,141,993 tons; Alabama came second, with 2,552,246 short tons, an increase of 403,335 tons; West Virginia third, with 2,516,505 short tons, an increase of 232,805 tons; Virginia fourth, with 1,124,572 short tons, an increase of 217,442 short tons; Colorado fifth, with 1,003,393 short tons, an increase of 332,090 tons—the percentages of increase for these States being Pennsylvania, 14.92; Alabama, 18.77; West Virginia, 10.19; Virginia, 23.97; Colorado, 49.47.

The quantity of coal used in 1902 to produce 25,401,730 short tons of coke was 39,604,007 short tons, as compared with 34,207,965 short tons used to produce 21,795,883 tons of coke in 1901, an increase of 5,396,042 short tons of coal in 1902 over 1901. The value of the coal consumed increased from $31,378,631 to $39,301,194. In 1901 the value of the coal used in making a ton of coke was $1.44, and the average price per ton for the coke produced was $2.04, a difference of 60 cents on each ton. In 1902 the value of the coal used in making a ton of coke was $1.54, and the average price per ton of coke was $2.49, a difference of 95 cents on each ton of coke.

The quantity of coke imported into the United States in 1902 amounted to 140,488 short tons, valued at $423,755, as compared with 72,727 short tons, valued at $266,075, in 1901. The exports of coke in 1902 amounted to 419,590 short tons, valued at $1,785,188, as compared with 430,450 short tons, valued at $1,561,898, in 1901.

SUN DIAL WITH ELECTRIC BELLS.

THE perfection that the manufacture of cheap clockwork has reached has caused the use of sun dials to be forgotten. Everyone owns a watch, and, except for the purpose of setting it, has no need to consult public clocks. But to select a clock that gives the exact time is often a difficult matter. When, in provincial cities, we hear midnight sound in the silence of the night, the twelve strokes are often repeated in succession for ten minutes, provided the number of clocks be somewhat large.

We have railway stations to fall back upon, but it is necessary to visit them; and then again it is only upon the track that we find the legal time (5 minutes too slow), the out-of-door clocks presenting a variable difference. The most convenient thing is to have at home a reference mark which shall give the passage of the sun at the meridian, and according to which the exact time may be found. Such reference mark, determined by the north-south direction, may be easily established in several ways, viz., by means of a compass, by an observation of the corresponding heights of the sun, or by an observation of the polar star. But with this reference mark (formed of a vertical or horizontal line) once drawn, the problem becomes complicated by several corrections. We know that the time that separates two successive passages of the sun at the meridian is not always the same, and that as a consequence of such want of uniformity, there is, save for four days in the year, always a difference between the time of an accurately regulated clock (mean time) and the time indicated by a sun dial (true time). Such difference, which is called the time "equation," is shown on February 10 by a retardation of 14.5 minutes, and on November 3 by an advance of 16.5 minutes of the solar hour, or a total difference of 31 minutes. Moreover, the legal time for entire France has, since 1891, been Paris time, and it follows that, according as a city is to the west or east of Paris, it is necessary to make an addition to or subtraction from the local time. The sun dial at Brest marks noon when that of Paris indicates 27 minutes past 12, and that at Nice 47 minutes past. At the same legal hour at two points of France the difference is therefore considerable. Such calculations, although simple, become tiresome by their repetition and necessitate the use of a table of time equations whenever they are made. It is necessary to watch for the moment, and then to put one's self to the trouble of observing the passage of the shadow over the meridian. It was in order to do away with such necessity that was installed the legendary cannon of the Palais Royal, the detonation of which announced to the whole neighborhood the passage of the sun over the meridian. But in addition to the calculation, it was necessary to load the gun after every detonation, and then, since the sun is constantly changing its inclination upon the horizon, almost daily to shift the lens that concentrated the solar rays upon the touch-hole of the gun.

It was therefore natural to think of replacing the gun by electricity, which lends itself to every use possible, and then to effect automatically both the inclination of the lens and the correction of the equation of the time. In the apparatus that we are going to describe, it is possible to obtain such results with certainty.

The apparatus is supported in its entirety by a platform, *A B*, mounted upon leveling screws (Fig. 1, No. 1). *C D* is a frame movable around two pivots, *C* and *D*, established in such a way that the line that passes through these pivots is placed in the meridian and parallel with the axis of the world. A clock-work movement, *E*, wound up every two months, is placed upon the frame to the west of the meridian, in such a way that its weight shall tend always to bring the frame to this side. A wheel, *E′* (Fig. 1, No. 2), of the clock movement makes one revolution in three days, and is provided with a tooth, *F*, which actuates a 122-tooth ratchet wheel, causing it to make one revolution in 366 days, or in the space of a year. The arbor of this wheel is placed in the direction of the axis of the world, like *C D*, and is supported by the frame. Upon this same arbor is keyed a hollow cylinder, *K*, of varying width such as would be given it were it intersected by an oblique plane, and upon the upper edge of this cylinder bears a roller, *L*, mounted in the end of a rod like an inverted T in shape, with chains attached to the ends of the cross-arms running over sectors, *N N*.

These sectors rock the two arms carrying a lens, *O* of which the focus is likewise projected upon *C D*. The whole is carried by the frame. The roller, *L*, bears upon the widest point, *a*, of cylinder, *K*, on the twenty-second of June, and on the lowest point, *b*, on the twenty-second of December, while all the intermediate positions sensibly agree with the declination of the sun for each day. The focal axis of the lens, from the highest to the lowest point, becomes displaced by an angle of 46 deg. 54 min., or about double the obliquity of the ecliptic. It is thus always placed

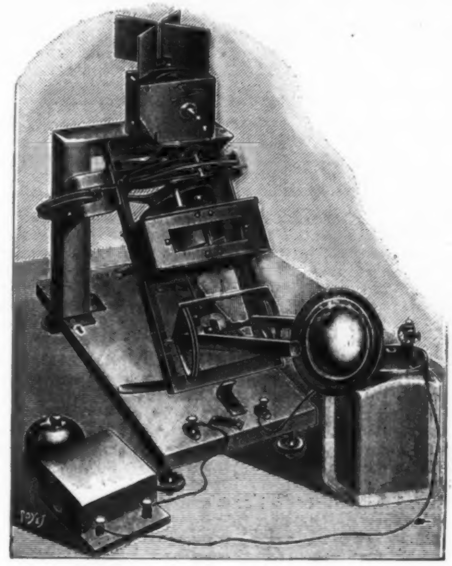


FIG. 2.—GENERAL VIEW OF SUN DIAL.

in the direction of the solar rays. Upon the same arbor is fixed a cam, *H*, the contour of which is determined by a succession of points whose distance from the center of rotation represents, for each day, the value of the time equation. The greatest divergence, *Z b* (Fig. 1, No. 2), corresponds to the 10th of February (14 minutes, 2 seconds retardation) and the least, *Z m*, to the 3d of November (16 minutes, 20 seconds advance). Against the periphery of *H* bears a roller, *I*, mounted between two plates, *J J′*, which slide upon two supports on the stationary frame. A chain, *S*, having one end attached to these plates, passes over the pulley, *Q*, fixed upon the same frame, and has its other end fastened to the sector, *P P′*. This sector is operatively connected with the movable frame. The weight of *E* tends to incline the frame, with all the parts that it carries, toward the left of the sector, while the chain offers an opposition thereto by holding back the sector, and at the same time exerts a pull upon *J J′*. But, when the arm revolves, it presents, as a bearing point to the wheel, *I*, points of the circumference whose distance from the center is less. The slide, *J J′*, accordingly recedes, and the chain unwinds and allows *P′* (Fig. 1, No. 2) to move away from the pulley, *Q*. The entire frame participates in this motion, and, pivoting around *C* and *D*, inclines toward the left. When the distance from the center to the periphery of the cam increases again, it returns toward the right.

At Paris, the true noon agrees with the mean noon on the 16th of April, 15th of June, 1st of September, and 25th of December. On these days, the frame inclines neither to the right nor the left, and the focal axis of the lens is exactly in the plane of the meridian. When the sun crosses the meridian after mean noon, the lens, by inclining to the right, gets in line with the sun before true (solar) noon; and when the sun crosses the meridian before mean noon, the lens inclines to the left and is not in line until after its passage of the meridian. The focal axis is thus displaced by a total angle of 7 deg. 42 min., corresponding to a difference of 31 minutes of time. In this double motion of right ascension and declination, the focus of the lens is always projected at the same point.

At the point where the calorific rays become concentrated is placed a small barometric chamber, *T*, of a U-shaped tube containing mercury and ether. Two insulated iron wires descend to the mercury and are connected with one or more electric bells placed at any suitable distance. When the focus forms upon *T*, the ether expands and acts upon the mercury, which, in contact with the naked extremities of the wires, completes the circuit, thus ringing a bell, and indicating mean noon to those interested (Fig. 1, No. 3).

The apparatus may be installed at any point whatever of France after regulating it once for all by means of the leveling screws. A very ordinary clockwork movement is sufficient, since a variation of one hour a day could not possibly vitiate the result. It suffices to set it at the time of winding. Upon fixing to the frame a rod to prolong the axis, *C D*, and surrounding it with a concentric half-cylinder attached to the dial, there may be obtained a sun dial that gives the various hours in mean time upon equal divisions traced in the interior of the cylinders.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

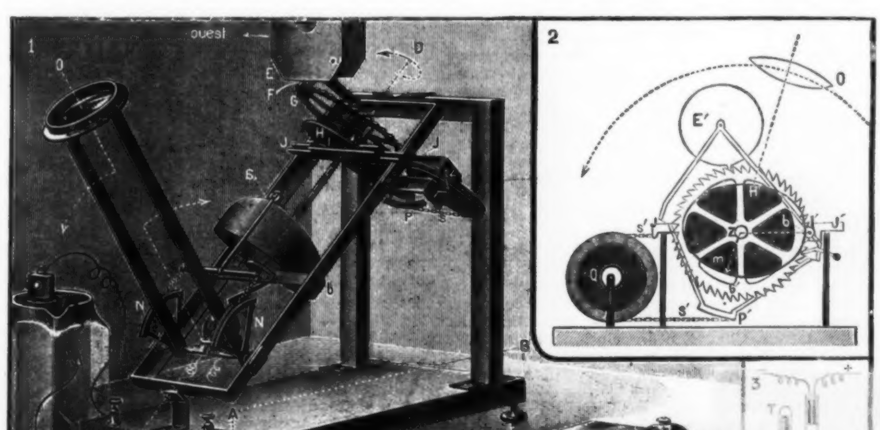


FIG. 1.—SUN DIAL WITH ELECTRIC BELL.

1. View of details. 2. End view. 3. Barometric chamber.

"DIM RELIGIOUS LIGHT."

THE "dim religious light"—a phrase which Milton made immortal—was supposed by him to be caused by the stained glass with which church windows were richly dight. His experience is believed to have been derived from visits to Old St. Paul's. It would be unfair to the great poet to imagine he was not acquainted with many other Gothic buildings in England. Milton, and most of his contemporaries, may have found some inconvenience in mediæval churches when they tried to read their prayer-books. The type employed was not always clear. Indeed, it has been advanced that the increased area of the window openings which characterizes the perpendicular style in England was mainly due to a desire to enable people to make use of printed pages during services. Caxton did not appear in Westminster until the end of the fifteenth century, and large windows were to be observed in earlier buildings. One of the reasons for the change in size was the increased power of the artists, by which they were enabled to undertake elaborate pictorial subjects. There can also be no doubt there was a tendency to arrangements which allowed the introduction of white glass. But what is remarkable is that it preceded rather than followed the adoption of printed books. At an earlier time prayer-books were not unknown, but very few people in an English parish were able to purchase an illuminated Book of Hours, and there would be little use in lending one to them.

The dim religious light was, however, a very ancient characteristic of temples as well as churches. The old temples were looked on as shrines to be only entered by priests and favored persons. The few legends which have come down to us about crazy devotees remaining in Greek temples during a night, reveal, by the circumstances described that the sanctuaries were vacant. Although it was considered a crime to abstract an object from a temple, yet there were too many treasures deposited in them to allow of unrestricted admission. The inclosures were jealously guarded, and the existence in some of an *opisthodomos*, or rear division, proves that precautions were taken for the preservation of valuable offerings. The Greeks or Romans could not possess strong rooms like those in a modern bank, because they had not attained the necessary mechanical skill. But as royal treasuries were sometimes lined with metal plates, we may be sure the gifts bestowed on the deities were no less securely protected against thieves. The lighting of Greek temples is a subject on which it would be absurd to be dogmatic, but the general impression which the references to them make on the mind of a modern student is that the interiors excited awe, and that effect was not likely to be produced with a strong light.

The earliest Christian places of worship are usually thought to have been the catacombs. Afterward it is probable the meetings were held above ground, and it may have been in public gardens. But the tradition of gloom long continued to exert an influence in the church. When basilicas and other large halls were made available for Christian worship the openings for light were perhaps not always obscured. Other means were adopted. There are statements in early writers which are presumed to mean that curtains were drawn at certain parts of the service, and those who officiated were concealed from view. It has even

been asserted that the iconostasis in the Greek churches, and the chancel arches and screens in some western churches, are survivals of the old arrangements to express a mystery. Those structures were equivalent to a darkening of the church. The crypts and "confessions" in Gothic and Romanesque churches also point to a period when darkness was held to be an auxiliary to religious emotions, and therefore to devotion. To recall the times of persecution when the faithful celebrated their rites in the catacombs or on the tombs of the martyrs, a cave was excavated under the altar, says De Caumont, in which were deposited the remains of Christians who died in the odor of sanctity. In Gaul, according to the same authority, the early Christian converts worshiped either privately in their own houses or together in crypts and retired places. The only example which has survived is the crypt of St. Gervais at Rouen, which is said to date from the fourth century. In it the body of St. Milon was interred. The churches of the fifth century in France were believed to be not only large, but even magnificent. The windows, however, were small, not more than 3 or 4 feet in height and 1½ or 2 feet in width.

In foreign countries, where the light was often oppressive, means were taken to guard against its ingress. The Greek houses were dark. Pompeii, which was a place for repose, does not add much to our knowledge of ancient fenestration. The recognized discomfort of the sun's beams is suggested in all the old Italian churches. Yet we suppose few travelers would hesitate to acknowledge the feeling of relief enjoyed on passing into one of them from the torrid streets. All our modern notions about the efficacy of light as a sanitary agent were unknown in former times. In Dante we find expressions which suggest a dread even of the light of Paradise, for he admits:

"Not long could I endure the ardent glow;
Yet long enough to see sparks burst around,
Such as we see from red-hot iron flow."

His combination of light and heat is suggestive of discomfort, and the manner in which the southern people sought to temper the fierce light which prevailed for several months. In all such cases we must not judge by the standard to which we are accustomed. In our dull climate we can bear with an area of glass which would be oppressive to the eyes of an old Italian. Even in western hospitals the admission of light is not feared. But a Greek or an Italian who spent the greater part of the day out of doors considered semi-darkness as reposeful. The dim religious light of churches was grateful to him. There was no need to use a prayer-book. It was an advantage to have the ceremonies veiled, as it were, by cloudiness, and if he could not see the preacher he was at least able to hear him. It was, therefore, easy for the custom to arise by which small windows were more necessary for churches than for ordinary buildings. In course of time, by the power of association, their use became identified with ecclesiasticism. We should also remember that in all ages men of gloomy dispositions have considered their rightful place was among the clergy. To them churches destitute of ornament, in which light was barely visible, seemed to be the best adapted to contain sinners who were obliged to listen to discourses in which men were to be moved to terror. According to some inquirers, Brunelleschi was the first of the Italians who dared to abandon the Gothic devices for restricting light by opening windows which were free from obstacles, and which removed the old auxiliaries to mystery. The experiment was made at the beginning of the fifteenth century, and may thus be said to be almost contemporary with similar efforts in the north of Europe to facilitate the admission of light. Only in some of the buildings of Venice was the old Eastern and Gothic tradition preserved.

It is not necessary for us to trace the advancement in Gothic windows. Too often the subject is treated as if it signified only changes in the form of tracery. Narrow windows for several centuries prevailed in England. Light was obscured by means of columns and arches, and, as sometimes happened, the stonework was doubled for the sake of artistic effect, so that the window became a small arcade of one or two bays. It cannot be urged that any inconvenience was suffered by the congregations. The services corresponded with those in Italian and southern churches. People were able to take part in them without opening their eyes, and, indeed, in many representations of saints we see the eyes closed or downcast, as if devotion were best maintained in that way.

The people in general could not have been dissatisfied if there was obscurity in the churches. In their own houses they considered small windows possessed many advantages. In disturbed times they helped to make their homes more easily defended. They were opened in the walls as near as possible to the ceilings so that entrance from without might not be facilitated. This is evident from Chaucer's description, where surprise is expressed that a window was so low as to be at the level of a man's breast. The Miller in his tale says:

"He cometh to the carpenteres hous,
And stil he stante under the shot window,
Unto his brest it raught, it was so low."

In shops or booths which were on the level of the ground the openings could hardly be called windows. During the day there was no frame with glass, and at night a shutter on hinges, which was fastened to the ceiling, was let down for protection.

The desire for light shown by perpendicular windows in churches, and in such buildings as St. Mary's Hall, Coventry, was also exemplified in many of the great mansions. The openings were extended until at length they became almost excessive, for buildings ceased to present the appearance of solidity which at one time was considered necessary. Wotton must have had the weakness in his mind when he warned his readers against making a house all eyes, like Argos. There was no part more expensive or more ruinous, he said, not only from being exposed to the violence of the weather, but on account of the "different and unsociable pieces, as wood, iron, lead, and glass, and those small and weak." Wotton seemingly favored allowing some darkness in churches, for devotion, he said, more required collected than diffused spirits. His suggestion was not adopted. English churches for the reformed ritual were slow in coming, but after Milton's time, when there was a call for them, it was not reckoned necessary that the lighting in order to be religious should be dim. Wren's London churches, by their large windows, enabled the citizens to read their prayer-books and hymn-books, and as Hogarth has recorded, the industrious apprentice and his master's daughter were able to read out of one small volume. A new symbol was created and light was reverenced as the "offspring of Heaven first-born" and the "bright effluence of bright essence increate," which could nowhere be more fittingly introduced than in churches.—The Architect and Contract Reporter.

[Concluded from SUPPLEMENT No. 1448, page 23199.]

MINING AND MANUFACTURE OF ROCK-SALT.

3. *Steam Evaporation.*

Steam Kettle Process.

THERE are two salt blocks in the Wyoming Valley, at Warsaw, in which the Onondaga kettles are used for the manufacture of salt, but these kettles are heated by steam instead of direct fire. Hence, in place of the brick arches in which the kettles are hung at Syracuse, they are supported by a frame work, and each kettle is surrounded by a steam jacket covered with a non-conductor. Moreover, the metal of the kettle is made much thinner for the better transmission of the heat. The steam enters the jacket at the upper end of the kettle and at one side and the condensed water escapes by a valve below it, to be returned to the steam boiler. The method of manufacture of the salt does not differ in any particular from the Onondaga method. The heat of the steam being uniform for all the kettles, the salt produced is uniform in grain and very good in quality. The number of the kettles under one roof or in one salt block can be varied according to the wish of the manufacturer and the steam capacity of the boilers.

The quality of the salt is primarily dependent on the attention of the workman, on the chemical composition of the brine, on its proper settling, on the length of time a block has been in operation, and on the amount of calcium and magnesium chlorides present in the pickle, since an excessive heating of the front kettles, especially when they are low in the pickle, will cause a decomposition of the magnesium chloride into magnesium oxide and hydrochloric acid; the latter readily attacks the iron, forming ferrous chloride, the slightest trace of which, when present in the salt, will cause a decided discoloration of the latter at the time the salt becomes ready for the market.

The grain of the salt, namely the size of the crystals, depends on the temperature at which the salt is made, and consequently on the quickness or slowness of the evaporation. The separation of the salt or its crystallization in a heated brine begins at the moment when the latter has reached its point of saturation. This crystallization always takes place on the surface of the brine and never at the bottom, since there the temperature is highest, and salt is more soluble in the hotter brine. The little cubes will increase in size as long as they remain on the surface of the brine but not when they have once sunk to the bottom of the heated liquid. Hence, to produce a coarse salt, the brine must remain as much as possible undisturbed in order to allow the crystals to grow, which is impossible in a very hot brine.

The salt made by the ordinary kettle method is not of a uniform grain or crystal, since the front kettles, which usually boil very rapidly, yield a heavy salt of which the crystals are small, hard, and sharp to the touch, while the back kettles produce a very light, flaky, and coarse-grained salt very soft to the touch. By mixing both a good grained average salt is obtained, which is known in the market as "common fine salt."

The average composition of this is about as follows:

	Per cent.
Sulphate of lime (calcium sulphate)	1.30
Calcium chloride	0.16
Magnesium chloride	0.15
Sodium chloride salt	95.49
Moisture	2.90

Since the year 1862, there has been produced at Syracuse a salt of very superior quality for the dairy and table, the manufacture of which has of late been abandoned. The process consisted in washing the common fine salt described above in a machine with a pure salt pickle holding in solution the necessary amount of sodium carbonate for the decomposition of the small percentages of calcium and magnesium chlorides, yielding salt and calcium and magnesium carbonates in a very fine state of subdivision, which readily floated off with the brine or pickle together with some of the calcium sulphate adhering to the salt. After proper drainage, the salt was dried in large iron driers lined with wood (the so-called "Hersey drier"), ground and sifted. The peculiar tendency of Onondaga boiled salt, when dissolved in water, to impart to the latter a milky appearance, is due to the presence of calcium sulphate in the anhydrous state, known as plaster of Paris. If the solution be allowed to stand for some time, this plaster will take up its water of crystallization and redissolve.

There are at present about 40 separate wells in 5 groups on the reservation. The brine comes within 18 to 22 feet of the surface. They are all tubed with 6 or 8-inch tubes and the brine is drawn from them by plunger pumps.

The Grainer Process.

The grainer or Michigan process is, like the "kettle method," a purely American invention and consists in passing live or exhaust steam through a set of iron pipes immersed in long shallow wooden or iron vats. These vats rest on a strong wooden frame. They are usually from 100 to 150 feet long, 12 feet wide, and from 20 to 24 inches deep; provided with 4 to 6 steam pipes having a diameter of 4 to 5 inches, and hung on pendants 4 to 6 inches above the bottom of the vats. These pipes are within a few feet of the same length as the grainer, and so arranged that the salt can be conveniently removed toward the outer side of the grainer. Over the top of the grainer is a strong platform to receive the salt taken from it for proper drainage; this also supports the pendants holding the steam pipes in their position. In most of the grainer blocks the salt is removed from the grainers by attendants called "lifters." In others an ingenious device called a "raker" does this work, automatically moving the salt constantly from the front end of the grainer to the back, where it drops into properly constructed "conveyers" which deposit it in the salt bins. Where no rakers are employed, the salt is removed every 24 hours. The brine, which is "settled" in exactly the same manner as that treated by the kettle and pan methods, is allowed to run into the grainers at the front end in the same proportion as the water evaporates from the brine. The only attention required, when the salt is not "lifted," is to pay proper attention to the supply of brine and the regulation of the steam. This is all attended to by one man. In most work soft coal is used as a fuel under the boilers, that and the expense for the fireman being a considerable item in the grainer plant. To obtain the best effect in a grainer system, the temperature of the heated brine should be kept at or near the boiling point when no lifting or removal of salt is in progress. To do this we must first supply to the grainers an abundance of high-pressure steam, and secondly the constant supply of brine required for the grainers while evaporation is going on must enter at a temperature but little lower than that of the brine in the grainer. For this purpose two large tanks, so-called settlers, are employed, which are usually as long and wide as the grainers, but 6 feet deep and provided with four rows of steam pipes, about 1 foot above the floor, to heat the cold brine drawn into them from the outside cisterns as required. Although the 6 rows of steam pipes in the grainer have an entire length of from 550 to 750 feet (suspended in the brine 4 to 6 inches above the bottom of the grainer and with 8 to 10 inches of brine above them) and a heating surface of from 700 to 1,000 square feet, a great deal of the steam supplied to them is not condensed, and therefore passes from the grainer pipes into the settler pipes (sometimes passing through a steam trap to separate the condensed water) to heat the brine of the settlers. Whenever there is a surplus of steam, for instance while the lifting of the salt from the grainers is going on, the direct steam is used for the same purpose. To produce the best quality of salt the pickle in the grainers must not become overcharged with calcium and magnesium chlorides, which can only be done by removing from time to time the inferior pickle. Since this pickle contains from 18 to 20 per cent of salt, too valuable to go to waste, it is discharged into a set of grainers on the ground floor of the building, called lower or divided grainers. They are placed either directly under the upper grainers, in which case they are but 8 feet wide with 4 steam pipes, or in some other convenient place. The pickle is heated in them by uncondensed steam and condensed water coming from the steam pipes in the settlers and upper grainers. The product of these lower or divided grainers in consequence of the low temperature at which the salt is made in them, is very coarse, often having an inferior color. The salt is removed from them at longer intervals—every 6 or 10 days according to circumstances—and the remaining pickle is discharged as useless. The removal of the salt into the bins, etc., does not differ in any essential from what has been stated in regard to the other methods.

4. *Vacuum Pan Evaporation,*

or the evaporation of water from brines by steam, with a reduction of atmospheric pressure over the heated brine, has been successfully introduced into two localities in this State, namely at the Duncan Salt Company's works, Silver Springs, Wyoming County, and at Ludlowville, Tompkins County. At the former place the process is carried on under the Duncan patents and at the latter under the Alexander Miller patents. Their product is a very handsome salt with a fine luster and very even grain, well adapted for table and dairy salt. The following generalized description of the former is furnished by Mr. W. C. Clarke, M.E.

The vacuum process consists in evaporating the brine in a large vertical cylindrical iron vessel in which a vacuum is produced. By withdrawing the atmospheric pressure, the boiling point of the brine is lowered, whereby a quicker crystallization is produced and consequently a finer grain. In the pan are 17 or 18 groups of copper tubes, 20 tubes in each, the latter being parallel to each other and in one plane. At each end they are connected with an iron tube or heading at right angles to the copper tubes and in the same plane, through which steam from the outside connections is admitted to supply heat for evaporation. The copper tubes are surrounded by brine. The salt, as it crystallizes, collects in a large pipe at the bottom of the pan, and, when it is seen through a peep-hole in the latter, a valve is closed above the salt and it is dumped into a cylindrical screen revolving at about 600 revolutions per minute. The water is thrown against the screen and goes through by centrifugal force. The salt when dry, is ready for packing. This is the Worcester brand and a price much above that of the ordinary grainer salt is obtained for it.

Comparison of Brines and Processes.

As the brines used in the western part of the State —where the pan and grainer methods are exclusively employed—are derived from the same salt deposits that supply Syracuse, and which are situated in the Salina Group, they do not differ materially in their chemical composition, the main difference being rather one of concentration. The amount of calcium sulphate present in the brines is dependent, as at Syracuse, upon the quantity of calcium chloride contained in them.

There is one remarkable fact to be recorded in this connection, namely, that while the brine from a new well usually contains calcium and magnesium chlorides in very small quantities, an increase of them is noticed after a time, especially when several wells very near each other become connected under ground. The most plausible explanation which can be offered for this is that the shales above the rock-salt—almost all the wells in the western part of the State are sunk in the rock-salt—may be highly charged with these soluble chlorides, and that when the salt surrounding the tubing of the well has been dissolved up to these overlying shales, the chlorides of the alkaline earths find easy access to the brine. Mr. I. P. Bishop states that he was informed by Mr. C. Q. Freeman, vice-president of the Retsof Mining Company, that a number of analyses of salt were made under his direction and that the samples taken from the top of a salt bed contained a greater proportion of deliquescent chlorides than those taken from the bottom. Whenever two or more wells belonging to the same company are found to be connected under ground, the so-called forcing process is resorted to, which consists in pumping fresh water to the salt bed below by powerful pumps. Through one well (tubing) the water is forced down while the brine comes up through another. This may possibly have some influence on the overlying shales. As examples to show the quality of the western brines the following two analyses may serve:

	Wyoming Valley Brine.	Genesee Valley Br'e.
Specific gravity	1.20446	1.1891
Calcium sulphate	0.4430	0.3780
Calcium chloride	0.1380	0.1913
Magnesium chloride	0.0530	0.1897
Pure salt	25.7110	24.1221
Water	73.6550	75.1189
	99.9500	100.0000

The following two analyses of the same brines after the lapse of considerable time exemplify the above statement:

	Wyoming Valley Brine.	Genesee Valley Br'e.
Specific gravity	1.1924	1.20446
	Per cent.	Per cent.
Calcium sulphate	0.433	0.407
Calcium chloride	0.069	0.140
Magnesium chloride	0.143	0.322
Pure salt	25.008	25.564
Water	74.347	73.567
	100.000	100.000

Before considering the special advantages of the various methods, it is but proper to offer a few general remarks on evaporation. Water, when it comes in contact with air, yields vapor, and the amount of the latter is always dependent on the temperature of the former. The formation of vapor always takes place on the surface of the water so long as the boiling point is not reached. If spontaneous or assisted by artificial means, it can only occur with the assistance of heat, and if there is not a direct outside source for this heat, it is extracted either from the parts surrounding the water or from the latter, thereby reducing its temperature.

When the formation of vapor takes place, not only on the surface of the liquid but also within it at the bottom and sides of the vessel exposed to a source of heat, the liquid boils. In evaporation the formation of vapor takes place on the surface; in boiling within the liquid. The former is a slow, the latter a quick method of evaporation. When water is heated in an open vessel to its boiling point, its temperature becomes stationary, and while a more intense heat increases the rapidity of evaporation, it cannot raise the temperature. Therefore the quicker we can supply the amount of heat required for the evaporation of a given quantity of water, the shorter must be the time in which it can be accomplished. A given quantity of water, exposed in two vessels, in one of which it is but 1 inch high and in the other 10 inches, to the same amount of heat on their heating surfaces, will evaporate in different spaces of time. The water in the vessel with the larger heating surface evaporates in one-tenth of the time of that in the other vessel, since the former has ten times more heating surface, and therefore transfers the heat ten times faster. Hence we may say, that the quantity of water that can be evaporated in a given time and at a given temperature is directly proportional to the area of the heating surface.

We assumed before that we supplied both vessels with the same amount of heat; could we raise the temperature under the vessel with the smaller heating surface, so as to impart to the water it contains as much heat as to our large vessel in exactly the same time, the result would be the same. Two vessels with equal heating surfaces and containing equal quantities of water, will show unequal results if one be heated more strongly than the other, the one more strongly heated evaporating more water in the same given time. With equal heating surfaces the amount of water evaporated in a given time is directly proportional to the temperature of the heated surfaces. The temperature at which water boils under ordinary circumstances at sea level is 212 deg. Fahr., but at high elevations where the air is lighter it boils at a lower temperature, and in deep mines at a higher temperature caused by the increased pressure of the air, hence it follows that the boiling temperature of water is dependent on the pressure of the air resting on the boiling liquid.

The fact is well known that water in an open vessel under an air pump where a vacuum is maintained, boils near its freezing point. The heat required for it is taken by the water from the surroundings, namely, the air pump. But to do this requires almost a perfect vacuum which we can not produce in practice, but we can readily boil water in a vacuum pan at 135 deg. Fahr. If the steam employed for this purpose is 250 deg. Fahr. then the difference between 135 deg. Fahr. at which the water boils, and the temperature of the steam supplied is 95 deg., then we can produce a very rapid evaporation provided we have sufficient heating surface at our disposal. Hence steam at any temperature will cause the evaporation of a liquid, of which the boiling point is below the temperature of the steam.

From the description given of the methods employed in the manufacture of salt, it is evident that a perfect comparison in regard to the practical results is a most difficult problem, since the quality of the brine and the fuel will often vary from week to week in the same work. Taking, therefore, the average results for a season or a year we find that with proper attention, good condition of the works and fuel, a kettle-block can produce 45 bushels (56 pounds each) of salt with a brine of 67 deg. salometer per ton of anthracite dust or, one pound of fuel evaporates 5.83 pounds of water, while a pan under the same conditions but with a brine of 96 deg. salometer yields 73 bushels of salt, hence a pound of fuel evaporates 6 pounds of water. The results with the upper (direct) grainer together with that of the lower or dividend grainer using a brine of 96 deg. salometer is 70 bushels, corresponding to an evaporation of 5.74 pounds of water per pound of fuel. These results are very low indeed as compared to those obtained in good steam boilers, but it must be taken into consideration that the conditions in both cases are very different. The expense for labor is greatest in the kettle method, next comes the pan and finally the grainer method. The wear and tear is very heavy in all salt works, but especially in kettle and pan block. Allowing a kettle or pan block to lie idle for a year almost ruins it, hence it is often cheaper to make salt for a season without profit than to leave the works to themselves.

The main difficulty with which the salt manufacturers of our State have to contend is the calcium sulphate or, as it is called by them, and very properly, the plaster. In fact it is this impurity, as I stated previously, which causes the interruption of the process and the laborious cleaning out, whether we use the kettle, the pan, the grainer, or the vacuum pan. It not only entails a great loss of heat in consequence of its low conductivity, but it also causes the overheating of the metal exposed to direct fire wherever this is employed. While this is of little consequence in regard to kettles, it is of great importance in regard to salt pans, since their bottoms have usually only a thickness of ¼ to ⅜ inch, and wherever they become coated with this plaster, especially above and near the fires, overheating and unequal expansion of the iron results, they warp, and become uneven. It can easily be understood that a proper removal of the salt from an uneven pan bottom is very difficult, and where the warping is bad it is impossible. In consequence the salt bakes on, is of inferior color, and the pan becomes leaky and has to be replaced, which involves often not only heavy expense but loss of time. The heating of the brine as much as possible in the back pan and the raising of its temperature near to the boiling point, in the second section of the front pan before passing it into the front section are of great service in the removal of all the calcium sulphate that can be removed under ordinary circumstances.

Suggestions and experiments have been made to overcome this difficulty, involving the expenditure of great sums of money, but without any practical results as far as mechanical means are concerned.

The chemical means proposed, especially the use of sodium carbonate and trisodium phosphate for the removal of the calcium sulphate from the brine, would involve not only a much heavier expense than the present price of ordinary salt will warrant, but by their use we would substitute sodium sulphate for calcium sulphate, which when present in the salt would be more objectionable than the latter. Moreover, the decomposition of the calcium sulphate by sodium carbonate or trisodium phosphate would involve at the same time the decomposition of the calcium and magnesium chlorides into calcium and magnesium carbonates or phosphates, thus bringing the expense for these chemicals up to such a high figure per bushel of salt that their use is out of the question.

The other impurities found in the salt brines of the State of New York which have an important bearing on the manufactured product are the very soluble and deliquescent calcium and magnesium chlorides. Although only present in the brines in small quantities, namely from about 0.15 to 0.75 per cent, they accumulate in the pickle or bitter water as the salt is removed, no matter by what method we obtain the salt. Thus in the solar salt fields they accumulate (gradually) in the pickle to such an extent, as previously stated, that evaporation practically ceases, when such a pickle contains only about 8 per cent of salt but nearly 21 per cent of the chlorides. In properly attended salt works the pickle is removed before such an accumulation of the calcium and magnesium chlorides takes place. It is usually discharged whenever it becomes necessary to scale the kettles, pans or grainer pipes, though in some grainer works a certain portion of the pickle is removed every two or three days from the upper into the lower grainers. When a certain ratio exists between the salt and these chlorides (especially the magnesium chloride) in a pickle evaporated by artificial heat a thin film is formed over the heated but not boiling liquid, which greatly retards evaporation and forms again as soon as removed. This is an indication that the chlorides of the alkaline earths should be removed.

It is not possible to obtain any accurate statistics concerning the amount and value of the total product of salt in New York. This is estimated for 1892 by Dr. F. E. Englehardt as follows:

	Bushels.
Western part of the State	11,500,000
Mined salt	7,000,000
Onondaga reservation	4,406,000
Grand total	22,906,000

Value per bushel between 7½ to 8 cents, dairy salt somewhat higher.

THE WORLD'S OCCUPATIONS.

The Statistical Register for the German Empire of 1903, which has just been issued in Berlin, gives some interesting figures as to the various occupations of the people of civilized nations. In Germany 8,300,000 persons, or 37.5 per cent of the total population of the empire, come under the head of agriculture and forestry. However, many persons are included in this total who only cultivate a small plot of ground. Under industry and mining come 8,300,000 persons, or 37.5 per cent; under trade and commerce, 2,300,000, or 10.6 per cent; under army and navy, 631,000, or 2.8 per cent; 800,000 persons, or 3.6 per cent, under other public callings, and 1,400,000 persons, or 6.1 per cent, under domestic servants. The following table shows the percentage of the whole population of the other countries under the headings agriculture, industry, and trade:

	Agriculture.	Industry.	Trade.
United States	36	24	16
Great Britain	15	54	10
England and Wales	10	57	11
Scotland	14	58	10
Ireland	44	31	5
France	44	34	9
Austria	38	37	11
Hungary	64	22	6
Italy	57	28	4
Switzerland	37	41	11

As regards the active callings of the female part of the population in the different civilized nations, only 14.3 per cent of the females in the United States follow any calling. Next to the United States come Holland and Sweden. The German empire has 25 per cent of its female population with a calling. This percentage compares favorably with others, and Germany stands on about the same level as England, where 27 per cent of the women are actively engaged in a calling. In other countries women are compelled, through economical conditions, to take part in much larger numbers in caring for the maintenance of their families. In Italy, for example, 40 per cent, and in Austria 47 per cent of the entire female population are actively engaged in earning their living.

TIME-SAVING IN WORKING WITH LOGARITHMS.

In finding seven-place logarithms of natural numbers having more than four digits, where the "difference" is not given at the side of the table, usually more figures are made than are necessary. I work as follows, with great saving in time, space, and eyesight over the usual method:

	722
	2356
log. 601.4538	2.7791634
722	388
1076	2.7792022
1076	
3766	
388.436	
	1298
1298	5259
log. 3345.637	3.5243961
	827
9086	
3894	3.5244788
7788	
826.826	

The two examples above given require little explanation. The mantissa of the first four figures is written down; that of the next higher four-place number placed above it; the difference above that; this difference placed over or under the remaining figures of the natural number and the latter muliplied thereby; the proportional part of the product set under the first-found mantissa and added thereto.

If the work can be done in less space and with fewer figures, I would like to know it.

Where the Dietrichkeit tables with interpolation-constants are used, the work for the same numbers may be as follows; but all do not have such tables at hand. The results are the same.

log. 6014 = 7791634	
log. 538	2.73078
plus interpolations-constant	0.63775
Sum	3.36853
less the first five figures of the log. of the first four numbers	0.77916
Diff	2.58937
Natural number of 2.5984 is	388.5
Add the log. of the first four digits	.7791634
log. of 6014583 is	.7792022
log. 3345 = 5243961	
Interpolations-constant =	0.63771
log. 637	2.80414
Sum	3.44185
less	0.52440
diff	2.91745
Natural number of 2.9175 is	826.99
log. 3345637 = log. 3345 + 827 =	5243961
add	827
Sum	5244788

Where a logarithm has a mantissa of only four digits, a table of antilogarithms comes in handy; thus:

Nat. No. of 0.9071 = 8.074209.
Nat. No. of 3.1234 = 1328.618.

Hanover, Germany. Robert Grimshaw.

THE VERNAISON SUSPENSION BRIDGE.*

By EMILE GUARINI.

AT Vernaison, France, upon the river Rhone, 8½ miles below Lyons and 5 above Girors, there has recently been opened a new semi-rigid suspension bridge, constructed by Teste, Moret & Co., of Lyons, under the control of the vicinal service of the Department of the Rhone. This bridge is worthy of attention because of the boldness of its conception and the lightness of its construction. It is 1,283 feet in length. The shore span on the right is 172 feet, the central span 763.6, and the shore span on the left, 139 feet. The width from side rail to side rail is 16.8 feet. The metallic part alone weighs 416 tons, or about 950 pounds to the foot. The cost of the masonry was $36,000, and that of the flooring and suspension $69,000. The bridge has no sidewalks, and there is space on the roadway for two carriages abreast. With the exception of the roadway, which is of wood, the entire structure is of steel. The girders, which are spaced 4 feet apart and extend from one side beam to the other, have the form of a solid, 8 inches in height at the extremities and 7 at the center. They consist of a steel web 3¼ inches in thickness, and of a double frame of 2¾ x 2¾ x 35-100-inch angle irons. They are connected longitudinally, in the first place, by 16 courses of 10 x 4-inch oak planks forming the bed of the roadway, and to which is nailed a sheathing of pine 2.3 inches in thickness; in the second place, by two string pieces of 9¾ x 5½-inch oak forming wheel guards; and, in the third place, by two stiffening girders forming a parapet 4 feet in height. These girders are divided into panels by uprights of double T-irons of 4 x 2.7 x 35-100 inches, placed at the right of the bridge pieces. The uprights are connected at the top and bottom by two courses of 5 x 2 x 3-10 inch U-irons, and in each panel, by a lattice work of 1-inch iron rods with turnbuckles for tightening them. Finally, the flooring is braced for its entire length by a double T-iron longitudinal of 5 x 3 x 4-10 inches, and, for its entire width, by half-flat iron diagonals, of which the section varies proportionally to the stresses.

The suspension is by means of 24 cables constructed, as usual, of wires in concentric layers and alternately twisted. Each cable is composed of 127 wires, each wire having a diameter of 3.95 mm. (.146 inch), and the whole forming a total section of 2.3 square inches. These cables are of steel having a resistance to traction of 20,000 pounds per square inch of section. They are connected with the flooring by vertical suspension rods 1 4-10 inches in diameter. At the approaches to the piers, for a length of 100 feet, these rods do not exist, and the flooring is carried by oblique cables (Fig. 3) starting from the summit of the piers and running to a longitudinal of double T-iron of 11⅜ x 5 6-10 x 4-10 inches, placed on corbels on the ends of the girders.

The suspension cables are continued from one shore to the other, and are not interrupted at the summit of the piers. They pass into the channel of a cast-iron carriage, which rests upon an apparatus that permits of balancing the tension of the cables under the influence of variations in temperature or of supercharge, and of transferring the vertical pressures to the masonry piers. The piers were built with the aid of compressed air. Their depth is 19.6 feet beneath low water mark, and their height reaches 101.6 feet. The stone work above the flooring consists of two towers, the one on the right shore being 73 feet high, and that on the left, 66 feet. The anchorage blocks are monoliths of masonry in which are formed galleries and sight-holes for inspection.

The putting of the suspension cables in place was effected by means of a carrier cable stretched temporarily from one shore to the other (Fig. 1). The putting in place of the girders (Fig. 2) was done by means of a second carrier cable passing through the double apertures in the piers, of a carriage provided with a block and tackle, and a traction cable.

After its construction, the work was submitted to tests by dead weight and by rolling weight. For the first, the three spans were tested, and then the entire bridge, by means of a supercharge of 40 pounds per square foot of flooring. The maximum deflection at the center of the middle span was 19¼ inches. For the test by rolling weight there were first employed two eight-ton wagons hauled by ten horses and crossing in the center of the bridge, and then an 11-ton wagon hauled by nine horses. In the first case, the sagging in the center of the central span was 12.7 inches, and, in the second, 12.8. The passage of the rolling loads caused only a slight vibration without rhythmic oscillations, and did no damage (any more than did the dead-weight tests) to the masonry, cables, or flooring.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT.

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

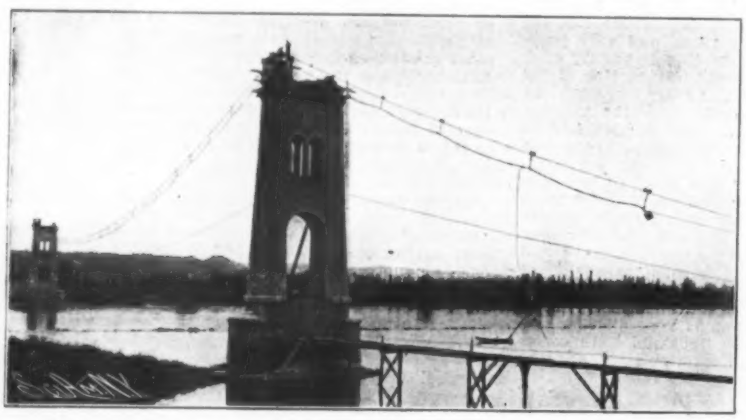


FIG. 1.—STRINGING THE CABLES

FIG. 3.—OBLIQUE SUSPENSION CABLES.

FIG. 2.—BUILDING THE FLOOR SYSTEM.

FIG. 4.—THE SUSPENSION BRIDGE AT VERNAISON ON THE OPENING DAY.

THE WIRELESS PROTOCOL.

THE final protocol of the international wireless telegraph conference, held in Berlin, was made public September 3 at the State Department. Brigadier-General A. W. Greely, U. S. A., was chairman of the American commission. This commission had no authority to make any agreement for the United States, but the protocol embodies in most of the essential features the views expressed by the American commissioners. Another conference will be held, and if all delegates have full powers, the protocol no doubt will be embodied in a treaty for the government of international wireless telegraph communication. The following is the text of the protocol:

ARTICLE I.

The exchange of correspondence between vessels at sea and wireless coast stations open to the general telegraphic service is subject to the following conditions:

First—Any fixed station, whose field of action extends to the sea, is styled coast station.

Second—Coast stations are bound to receive and transmit telegrams originating from or intended for vessels at sea without any distinction of wireless telegraph system used by the latter.

Third—The contracting parties shall publish any technical information likely to facilitate or expedite communications between coast stations and ships at sea. However, each one of the contracting governments may authorize the stations established on its territory, under such conditions as it may see fit, to make use of several installations or special arrangements.

Fourth—The contracting parties state and declare they adopt for the fixing of tariffs applicable to telegraphic traffic exchange between vessels at sea and the international telegraphic system the following basis:

The total tax to collect for such traffic is fixed by the words it includes (a) the tax appertaining to the traffic of the line of the telegraphic system, the amount of which is that fixed by the international telegraphic regulations now in existence appended to the St. Petersburg convention; (b) the tax appertaining to the maritime course. The latter is, as the first one, fixed according to the number of words, and such number of words being reckoned in accordance with the international telegraphic regulations mentioned in paragraph A, above. It includes:

First, a tax styled "coast tax," which belongs to the said station; second, a tax called "vessel tax," which belongs to the post established on the ship. A coast station tax is subject to the approval of the state on whose territory the station is established, and a vessel tax to the approval of the state whose flag is borne by the vessel. Each one of these two taxes is to be fixed on the basis of an equitable remuneration for the telegraphic work.

ARTICLE II.

Regulations which will be annexed to the convention that is to be perfected will establish the rules applicable to the exchange of communications between the posts and on board the vessels. The provisions of these regulations may be at any time modified by common understanding between the contracting states.

ARTICLE III.

The provisions of the telegraphic convention of St. Petersburg are applicable to the transmission of wireless telegraphy in so far as they do not conflict with those of the future conventions.

ARTICLE IV.

The wireless stations must, unless there should be absolute impossibility, accept in preference requests for help that may come from vessels.

ARTICLE V.

The service of wireless telegraph stations must be organized, so far as practicable, so as not to interfere with the service of other stations.

ARTICLE VI.

The contracting governments reserve the right to make separate arrangements for the purpose of compelling the contractors working within their territory wireless telegraph stations to obey only through other stations the modification of the future convention.

ARTICLE VII.

The provisions of the future convention are not applicable to wireless telegraph stations that are not open to the general telegraphic service, except in regard to the clauses embodied in Articles IV. and V.

ARTICLE VIII.

The countries that have not adhered to the future convention may be admitted on their making a request to that effect.

THE LEBAUDY AIRSHIP.

AFTER the sad accidents which last year, at a month's interval, marked the history of aeronautics with their bloody traces, we have a strong feeling of satisfaction and relief in finally registering a successful attempt at airship construction. The adverse fortune that was pursuing aeronauts seems at length to be shackled. Is the legitimate and deserved success of the Lebaudy balloon, constructed and experimented with, for the first time, by MM. Julliot and Surcouf, during last November, at Moisson, near Bonnières, and which is under trial at the present moment, due, then, to a new invention that breaks away completely from habitual practice? Not at all. Such success, justifying what wise people have always said, is, on the contrary, imputable, before all else, to the care with which the teachings of previous experiments have been taken into account (and this, in the first place, is a point upon which it is well to insist), and, at the same time, to the carefulness with which the preliminary tests have been made. The most experienced men in this new sport never tire of repeating that the conditions which regulate aeronautics and that are still quite mysterious in some points, have been so well elucidated that we do not have to confront totally unknown dangers when we try some new experiments; and that such dangers can be avoided in a certain measure through the application of the teachings of the past. It would certainly be too premature to proclaim that no more accidents will ever occur, although, by proceeding methodically, the chances thereof may be reduced to a minimum. This is demonstrated by the Moisson experiments.

If the Lebaudy balloon satisfies the conditions recognized at present as indispensable in the realization of every dirigible airship, it is nevertheless clearly distinguished from previous types, as a short description of it will show. The balloon proper is 187.5 feet in length. It is dissymmetrical, and the midship frame, 32 feet in diameter, is 82 feet from the bow and 105.5 from the stern. The elongation is 5.6 diameters. The point in front has the form of quite an elongated cone, while the stern terminates in a spherical cap. Finally, the greatest radius of curvature is 226 feet. The inflated envelope does not completely possess the form of a solid of revolution, but, at its lowest part, presents a flattening, as if it were intersected by a horizontal plane situated 11.5 feet beneath the axis. The edges of this flat portion are secured to an ovalized ring, forming a stiff frame of steel tubes, to which are attached the steel suspension cables. The platform also presents a peculiarity, and that is a sort of vertical false keel which traverses it from end to end, and of which the skeleton, of steel lattice work, is covered with a fabric at its back part. It is prolonged toward the rear by a long spar which has been found necessary for maintaining the rigidity of the rear cone, through stays, and for sustaining the rudder of 96.75 square feet. Finally, the rudder, which is horizontal, contributes toward assuring the stability on the route.

The envelope is of doubled thin cotton cloth with one interposed sheet of rubber only .004 of an inch in thickness. Rubber, as is well known, has but one drawback, and that is that it is liable to alteration under the double action of light and oxygen. In order to prevent the effect of sunlight, the fabric receives externally a dye that has given the Lebaudy balloon the popular surname of "Le Jaune" ("yellow"). In order to prevent the action of the oxygen of the air and, at the same time, to increase the impermeability, there is given to each of the surfaces from seven to eight coats of a special product called "balloonine," which consists of a solution of rubber in a mixture of benzine and sulphide of carbon. Of this, about one ounce is used per square foot of fabric. The larger part of it evaporates and leaves upon the envelope only the 120 grains of solid matter that the solution contains. The evaporation is so rapid that there results quite an appreciable cooling, which causes the two surfaces of the rubber to undergo a genuine effect of vulcanization. The fabric thus prepared weighs but 160 grains per square foot of envelope, inclusive of the stitching. It is so impermeable that the balloon, at the end of 40 days of inflation, undergoes no perceptible loss of gas. The tightness is therefore remarkable.

The car, which is suspended at 17.25 feet beneath the platform, is 15.75 feet in length and 5.5 in width. The suspension, which is very divergent, and triangulated according to the principles enunciated by Dupuy-de-Lome, is not effected by steel wire, of which the drawbacks are manifold, but by steel cables about one quarter of an inch in diameter and 28 in number. Such suspension renders the car and balloon absolutely interdependent—a condition indispensable for stability. In order to stiffen the entire affair, there is placed upon the front of the suspension an oblique thrust-frame of steel tubing, and, under the car, a sort of inverted pyramid, of the same material, which prevents the propellers at the sides from striking the ground should the car touch. In addition to the two aeronauts, the car carries a 40-horsepower gasoline motor that drives the two lateral propellers. Each two-bladed propeller is but 9 feet in diameter, but it makes up for its small size by having a great rotary velocity, which is about 1,000 revolutions a minute. Despite the accepted ideas that attribute more efficiency to large propellers revolving slowly, the builders express themselves as well satisfied with these high-speed screws. In order to obtain all the efficiency that these parts are capable of yielding, the blades are made of steel plate so as to assure perfect rigidity. The capacity of the envelope is 80,000 cubic feet. The fixedness of its form is assured by an air compensating balloon of 10,675 cubic feet capacity, reaching almost one-seventh of the total volume. The automatic safety valves yield only to an internal pressure of eight-tenths of an inch of water, and consequently assure a proper tension of the fabric.

The hydrogen, which is of very pure quality, is manufactured in a Surcouf generator.

The weights are thus distributed:

	Pounds.
Aerostatic part	1,056
Metallic platform	660
Car, motor, screws, and mechanism	1,760
Passengers	660
Gasoline, water, and ballast	1,430

With great prudence, the builders, before any free ascension, formulated a programme of severe tests of each of the parts and of the balloon itself in all the positions that it is capable of taking during the course of an aerial trip; and they endeavored particularly to assure themselves that no risk of fire would be run. With this object in view, jets of hydrogen under pressure, pure and mixed with air, were projected upon all parts of the machines. It was found that, owing to the precautions taken, no ignition was possible,

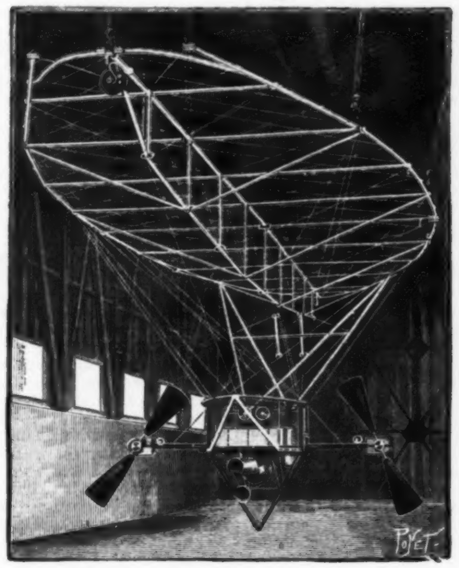


FIG. 2.—GENERAL VIEW OF THE PLATFORM WITH ITS FALSE KEEL, THE THRUST-FRAME, THE CAR, AND THE SUSPENSION.

either at the ignition contact box or at the exhaust of the gasoline motor. The same tests were made with some electric installations designed to actuate the ventilator of the air balloon during stoppages of the motor; and here the results obtained are worthy of mention. In the first place, it should be stated that it is impossible to ignite jets of gas upon the dynamo commutator under the most favorable conditions; that is to say, when, in consequence of shocks or vibrations, the brushes emit numerous strong sparks. It seems that the armature, in its rapid motion, carries along a stratum of air that prevents the contact of the jet of hydrogen; but, in return, the latter is always easily ignited at the connections of the accumulators. Under such circumstances, it was thought prudent to discard electric circuits as much as possible, and this was therefore done. The last experiments were tried in the open air. The balloon was set in motion with a guide rope attached, and a slight distance above ground. The experiment demonstrated the fact that it was perfectly stable and that its various parts operated satisfactorily.

All the preliminary experiments lasted twenty-one days, and it was not until November 13 that it was resolved to attempt the first free ascension, the wind at the time reaching a velocity of from 16 to 18 feet a second, at 328 feet above the ground. This experiment was a perfect success. The passengers were M. Surcouf, aeronaut; M. Julliot, engineer, and M. Oberlé, mechanic. One of the screws having got out of true on the day preceding, the navigators had to be content to proceed with a single one of these propellers, which was in a perfect state; and consequently but 20 horse power was utilized. It was found in the first place that, despite the eccentricity of this single propeller, placed at the side of the car, the balloon advanced in a straight line according to its axis. This shows how illusory it is to rely upon the inverse maneuvering of two lateral screws to produce changes of direction of the balloon and replace the rudder. The fact is explained by the shortness and slightness of pitch of the blades of each screw.

The speed obtained was not measured, but it may be estimated that the balloon under full power is easily capable of making 24 miles an hour, while preserving as perfect stability as it did at the time of the first experiments.

After three successful trips, MM. Surcouf and Julliot, desiring to study the motions of the balloon from the earth, gave way to the experienced aeronaut, M. Juchmes, who made a fourth trip which consisted in describing in the air a large and regular figure 8. The only incident to be noted is, that during an effort to turn about within a very short radius, the piece that sustained the rudder was bent under the heavy stress that was exerted upon the latter; but this did not prevent the landing maneuvers from being effected with sufficient correctness to bring the balloon to the point whence it started.

Upon the whole, the different ascensions made in a closed loop are absolutely demonstrative of the soundness of the principles followed in the construction of the airship.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from La Nature.

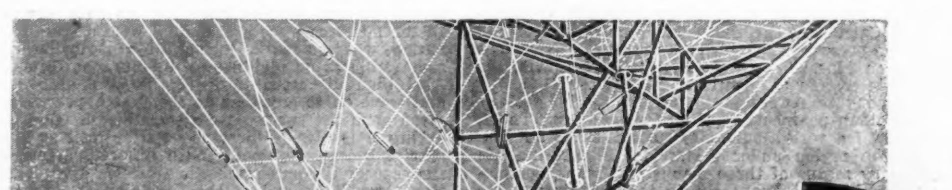


FIG. 1.—THE CAR DIVESTED OF ITS ENVELOPE; AND THE PROPELLING MECHANISM. ABOVE THE CAR ARE SHOWN THE THRUST-FRAME AND THE SUSPENSION CABLES.

THE NINTH INTERNATIONAL GEOLOGICAL CONGRESS.

By E. O. HOVEY.

VIENNA is noted among European capitals for the holding of conventions. This year the city received as its guest the ninth International Geological Congress, and for about a week (August 20 to 27) the halls of the imperial university were thronged with geologists from all parts of the world. The total number of members registered as being in attendance was 357 out of a membership of 636 for the year. These numbers are smaller than those for the Paris congress of 1900 and for the St. Petersburg congress of 1897, but the Exposition Universelle formed an additional attraction at the former city, while special facilities for visiting many parts of a country which usually is practically inaccessible influenced many to join and attend the meeting in Russia. There being no unusual feature in connection with the congress of the present year, the attendance at Vienna may be considered highly satisfactory, the number of members present in proportion to the enrollment being greater this year than three years ago. The programme was varied and the papers presented were of a high degree of merit and interest.

The formal opening of the congress took place Thursday morning, August 20, in the large assembly hall of the university under the patronage of the Archduke Rainer and the honorary presidency of W. von Hartel, Privy Councilor to the Emperor and Minister of Public Instruction. The welcome spoken by these officials was followed by the greetings expressed in the name of the university by the Pro-Rector, Prof. Schiffer, and in the name of the city of Vienna by Vice-Burgomaster Strobach. Replies in behalf of the congress were made by Prof. Capellini, of Bologna, the senior ex-president of the body, and by Prof. Barrois, president of the preceding session at Paris. Prof. Barrois also announced the election by the council of Prof. Emil Tietze as president and Prof. Charles Diener as general secretary of the congress.

In order to give definite direction to the deliberations of the congress, the committee of arrangements proposed three important general topics for discussion at the meeting: The present condition of knowledge of the crystalline schists; the problem of overthrust faults and exotic blocks; and the geology of the Balkan peninsula and the Orient. The presentation of the elaborate papers on these subjects and the discussions thereof occupied three days of the convention—Saturday, Monday, and Wednesday.

The afternoon of the opening day was devoted to

four lectures on different subjects, and the reading of papers was begun by Prof. A. Baltzer, of Berne, Switzerland, who described the laccoliths of the Aar massif, great intrusions of igneous rock which have played a vitally important part in the construction of this mountain mass of the Alps. The author explained the nearly horizontal alternations of massive and schistose rocks as being the result of lateral injections of the igneous rock into the adjoining sedimentaries, referring to the La Plata Mountains in Colorado for a parallel case. Following this speaker Dr. E. O. Hovey, of New York, gave a *résumé* of the geological observations made by him for the American Museum of Natural History on Martinique and St. Vincent after the eruptions of 1902. By means of numerous stereopticon slides there were shown the various phenomena of the eruptions, the destruction wrought in St. Pierre, the features of the ash coating on the volcanoes and of the erosion which took place between May and June, 1902, and February and March, 1903. The feature of most particular scientific interest is the pushing up of the great new cone with its enormous spine or tooth through the old crater of Mont Pelé. This spine in March, 1903, reached an altitude nearly 900 feet greater than the former height of the mountain, or 3,000 feet above the bottom of the old crater. There is no true crater in the new cone, but steam issues abundantly from all portions of it and the principal explosions take place near the base of the spine on the southwest and northwest slopes. The spine and most of the cone consist of solid rock (that is, not débris) which is sifted in every direction and which shows much incandescence at night.*

Venturino Sabbatini, of the geological survey of Italy, then spoke of the present state of studies upon the volcanoes of central Italy. His paper was the second in a series in course of preparation. He was followed by Prof. Albert S. Bickmore, of New York, who showed the geologists a series of remarkable pictures of Mauna Loa, Kilauea, and some of the extinct volcanoes of the Hawaiian Islands. Especial interest centered about the views of the boiling and spurting lava of the last eruption of Mauna Loa. These slides were exhibited as showing the manner in which material for the teaching of geography in the public schools of New York is being assembled under the direction of the lecturer at the American Museum of Natural History with the aid of a grant from the State of New York. Fifteen thousand negatives from all parts of the world are now the property of this department of the museum.

The next session of the congress (Saturday) was devoted to the first of the set questions proposed by the committee, and the following papers were read and discussed. By Prof. Becke, of Vienna, "On the crystalline schists with special reference to their structure;" by Prof. P. Termier, of Paris, on "The crystalline schists of the western Alps;" by Prof. A. Sauer, of Stuttgart, on "The crystalline schists of middle Germany;" by Dr. F. E. Suess, of Vienna, on "The schistose rocks of the Alps and vicinity;" by President Charles R. Van Hise, of Madison, Wis., on "The crystalline rocks of the United States of North America;" by Dr. J. J. Sederholm, of Helsingfors, Finland, on "The present state of knowledge of the crystalline schists of Finland;" and by Prof. L. Mrazec, of Bucharest, on "The crystalline schists of the southern Carpathian Mountains." This difficult but highly interesting and important theme was followed on Monday by the second set theme, which is almost as interesting and mooted: Overthrust faults and exotic blocks. Papers were read by Profs. V. Uhlig, of Vienna; M. Lugeon, of Lausanne; E. Haug, of Paris; F. Kossmat, of Vienna; A. E. Toernebohm, of Stockholm; Bailey Willis, of Washington, and C. L. Griesbach, of Calcutta. These discussed the phases of the subject as presented in the Carpathians, the Swiss and the French Alps, Carniola (Austria), Scandinavia, the United States, and the central Himalayas.

Wednesday was devoted to papers on the geology of the Balkan peninsula and the Orient. Prof. Toula, of Vienna, led with a summary statement of the geology of the region under discussion, illustrating his remarks by means of three manuscript maps, combining all the facts brought out in the literature. The author stated that the most important field work in the Balkans had been done by the Austrians, Tietze, Diener, and Schaffer, and by the Germans, Philippson and von Buch. The speaker considered doubtful the extent to which the great longitudinal fault and dislocation plane of the central Balkans could be correlated with the transverse fault near Scutari (Constantinople). The Balkan Mountains themselves diminish toward the Black Sea, but the principal features of the peninsula continue through the northwestern embayment of the Black Sea. Every line of shallow water of the Black Sea can be regarded as a submerged delta. The author closed by saying: "This region for centuries has been the battle ground of the nations. It has been and will continue to be a region of geological contest, with fair promise that in the end the knowledge of its structure will constitute fundamental and important progress in our science."

Prof. Cvijic, of Belgrade, discussed the tectonics of the Balkan peninsula. He said in part that the Rhodope Mountain mass formed a new type of the old masses in that it occurred between younger folded mountains instead of on the outside. The dynamic phenomena are characteristic, and indicate the courses of the younger fold-planes. This mountain mass was the starting point of these folds, and the younger dislocations of the Dinaric and Balkan systems bend away therefrom, those of the former as overthrust folds and those of the latter as inclined flexures. Between the old mass and every one of the mountains showing the later folding there occurs a transition zone, which indicates a differentiation of the older mass. In the Balkan system one must distinguish an old pre-Permian nucleus from a younger Oligocene-Miocene series. To the latter belongs the whole eastern portion of the Balkans, which is characterized by a new kind of folding called "intermittent" folding. At the base of the folded Balkans on the north there are overthrusts and reversed folds or flexures. In the Bulgarian plateau there are transverse synclinal and other faults. In the western Balkans especial interest attaches to the fundamental structure lines which have served to determine the formation of the transverse valleys. Cvijic distinguishes four tectonic elements in eastern Servia; he finds that the southern Carpathians and the Balkans are not related, and that the sedimentary zone of east Servia passes in contorted fashion into the Banat Mountains. Three old lines of torsion have a sheering influence upon the direction of the younger folds.

The third paper upon this interesting subject was by Dr. F. Katzer, of Sarajevo, Bosnia, and dealt with the present state of knowledge of the geology of Bosnia and Herzegovina. After referring to the work done in the region under peculiar difficulties by Tietze, von Mojsisovics and Bittner, Dr. Katzer continued: The chief question in the region was the relation of fundamental masses to the younger rocks. As fundamental rocks in Bosnia the Palæozoics are united with the lower Trias, but in the western part of the region upper Triassic seems to be distinguishable. From the Trias onward the Mesozoic strata are only incompletely exposed. It is an important fact that the youngest Jurassic rocks are always found in connection with the rocks of the so-called Bosnian serpentine zone. This serpentine series also has furnished the material for the conglomerates of the early Cretaceous beds. It follows that the Bosnian serpentine, which is generally considered to be of Tertiary age, must be older than the Cretaceous. It is even older than upper Jurassic, since beds of the Tithon period overlie it. There is nothing to indicate an age greater than Triassic and the probabilities are that the serpentine belongs to lower and middle Jurassic age. The speaker further called attention to the development of Cretaceous and Eocene strata, to the recently discovered distribution of massive igneous rocks, to the importance of the correct interpretation of the relations of the coal-bearing freshwater middle Tertiary beds, and to the geologically recent tectonic phenomena of the mountains. The succeeding papers by Prof. A. Philippson, of Bonn, Prof. L. Cayeux, of Paris, and Dr. G. von Bukowski, of Vienna, dealt with the geology of Greece, of the island of Crete, and of Asia Minor.

Of the sixteen papers read before the four sections of the congress during the morning of the last day, two were of particular general interest, one by Dr. Othenio Abel, of Vienna, on "The extinction of species," and the other by Claudius Angermann, E.M., of Lemberg, on "The occurrence of petroleum at Boryslaw in its relations to the dynamic geology of the region."

Dr. Abel began by recalling the theory of Cuvier of a century ago, that the faunas and floras of earlier geological periods were entirely different from those of the present. Cuvier and his disciples contended that the extinction of these life-forms was due to great catastrophes affecting the whole globe, and that after each of these catastrophes entirely new plants and animals peopled the earth. Lyell and his school denied this theory on the ground that changes in and on the earth had been gradual and without general cataclysms. Darwin, who was a disciple of Lyell, advanced the idea that the struggle for existence had been the principal cause for the disappearance of species. Recent palæontological investigations lead to conclusions which are not in accord with Darwin's theory. Weismann also is against the teaching of Darwin. In discussing the question, however, it is important to consider whether the forms which have disappeared have left successors which have endured to the present day, or have left no such successors. In the latter case we are dealing with a true extermination, whereas in the former we are considering the same animals or plants only in different forms. Dr. Abel then discussed in brief the laws of evolution, and went on to say that at the first appearance of a given stem the species are always small. One line of evolution is always increase of size, until at last the species becomes extinct. With different stems, as in the case of the ammonites, one can observe degeneration toward the end of the development. Extinction or extermination of species therefore depends not only on external, but also on internal causes, upon which finally the ability of change and adaptation to revised conditions depends. There is no predetermination of the disappearance of a species, nor is there any guarantee of its duration. The extinction of a species is dependent upon various causes, but in general it is safe to assert that the nearer the form of a species remains to the original stock, the longer it will endure, and the more it differs therefrom and becomes specialized, the less able it becomes to withstand changed conditions of life, and the sooner it disappears.

Mr. Angermann's paper on the petroleum deposits of Boryslaw in Galicia gave the results of extended study of the numerous borings, barren as well as productive, which have been made in that district. Some of the borings are more than 3,000 feet deep. In addition to petroleum the Boryslaw district furnishes a large amount of ozocerite or natural paraffin. Heretofore the Miocene age of the Boryslaw oil-bearing beds has been conceded, but the abundance of typical menilite in the exposures in the region of the borings leaves no doubt that the beds should be referred to the Oligocene. Pumps are not used in the field, siphons being found sufficient for raising all the oil. The upper sands are poorer in oil than the deeper. The seams of ozocerite closely accompany the oil and the indications are that boring for oil can be pursued profitably everywhere that these seams are found. The ozocerite is the residue left in fissures which at first were the courses of mineral-bearing waters, and then permitted the escape of gas and later of petroleum. Gradually the paraffin separated from the oil and finally filled the fissures.

The afternoon of the last day of the sessions, Thursday, August 27, was occupied in the first place by the reading of the reports of the standing committees. For the committee on the geological map of Europe Prof. F. Beyschlag, of Berlin, stated that the sheets covering Turkey and Asia Minor had been published since the Paris Congress, although at first it was thought that the incompleteness of the knowledge of those countries would make it necessary to omit them. So great has been the demand for the central sheets of the map, that the edition of 2,000 has been exhausted and a new edition must be printed. Sir Archibald Geikie, of London, presented the reports of the committees on the coast lines of the northern hemisphere and on the question of international co-operation in geologic work. Prof. D. Oehlert, of Paris, spoke for the committee on "Palæontologia universalis," a work which is to republish figures of all early type specimens, and Prof. S. Finsterwalder, of Munich, presented the report of the committee which is studying the glaciers of Europe. Prof. Charles Barrois, of Lille, announced that the Spendiaroff prize (established at the St. Petersburg congress) had been awarded to Prof. W. C. Brögger, of Christiania, for his classic work upon the rocks of the Christiania region. Mr. S. F. Emmons, of Washington, brought to the attention of the congress the great need of the establishment by some government or by some institution of learning of a thoroughly equipped geo-physical laboratory, where many of the fundamental problems of geology could be worked out along physical, chemical, and astronomical lines. After receiving and considering invitations from Mexico and Canada, it was voted by the congress to hold the tenth International Geological Congress in the city of Mexico in 1906. Votes of thanks were tendered then to the Austrian government, Archduke Rainer, Minister von Hartel, the city of Vienna, the university officials and the organization committee, and then the official life of the ninth International Geological Congress came to an end.

During the progress of the congress opportunity to see the geology of the region within reach of Vienna was given by means of several excursions. In this manner were visited the Miocene terranes of the Alpine basin of Vienna as exposed in the marine beds of Atzgersdorf, Vöslau, and Baden. Another excursion was to Eggenburg, to examine the Miocene beds of the extra-Alpine portion of the Vienna basin. Mineralogists and petrographers spent a day among the archæan rocks of the Waldviertel. The Semmering Pass with its marvelous scenery and its noted railroad were visited by one party on the same day that another party went to the Schneeberg. On the two days following the congress geographers went to Wachau, Kerms, Wienerberg, and Inzersdorf to study the valley of the Danube and its development, while another party visited Heiligenstadt, Nussdorf, and Kahlenberg. Before the sessions of the congress, there were offered to the members extended excursions in Bohemia, Galicia and Austria proper, while after the sessions opportunity was given to visit the places of chief geological interest in Bosnia, Herzegovina, Dalmatia, and the Tyrol.

The social features of the Vienna congress were particularly pleasant, and they evinced the hospitality of the Austrians. On Saturday evening the ladies in attendance and some of the men were invited to a gala performance at the Court theater, while others of the men were invited to dinners given by Profs. E. Tietze, president of the congress, Max von Guttman, treasurer, Edward Suess, R. von Mojsisovics, and G. Tschermak. Monday evening the city of Vienna tendered the congress a formal and elaborate banquet in the great dining hall of the beautiful Rathhaus. Complimentary luncheons and dinners were given in connection with several of the excursions. During the week the court library officials displayed their choicest treasures to the members of the congress, and in the Court Natural History Museum Profs. Fuchs and Berwerth at stated times showed members around the geological collection and the collections of rocks, meteorites, and minerals respectively. The meteorite collection is the most celebrated in the world, and some of its features were made the subject of a special lecture one afternoon by Prof. Berwerth.

The only exhibit made in connection with the congress consisted of a remarkable relief model of the Säntis Mountain region in Switzerland, constructed by Prof. A. Heim, of Zürich. Relief maps are not new; but this work of Prof. Heim's is more than a mere map, it is a reproduction of nature, as close as time, patience, and skill can make it. Most relief maps or models are copies in plaster of Paris of a topographic map, with the vertical scale exaggerated to from two to five times the horizontal, but this model of the Säntis group reproduces nature with scrupulous fidelity and the vertical and horizontal scales are the same. The scale is sufficiently large, 1:5000, or about 1 inch to 416 2-3 feet, to permit the representation of many minute details. The model is two meters (or 6½ feet) square, representing an area of about forty square miles. Prof. Heim and two assistants were at work on this model for more than three years, in the course of which more than 400 sketches were made and 800 photographs taken. The maker states that there is not a place a quarter of an inch square on the model which has not been fashioned in accordance with one or more photographs or sketches, and comparison with the photographs carried out his assertion. Conventional geological coloring was not adopted for the model, because it concealed the topographic effect; instead, colors conforming as closely as possible to those of nature were adopted. In order to get these colors as they should be, and to gain an accurate conception of the region from the same relative position as that from which the model would be viewed, Prof. Heim made four balloon ascensions. The geological as well as the geographical features of the region are shown on the model, the various overthrusts, overthrown folds, faults, etc., forming an instructive study in tectonics. So accurate is the model that every chalet and hayhouse is shown in exact size, form, and position.

Agricultural Machines in Russia.—According to the St. Petersburg Times, the demand for agricultural machines in the Siberian country beyond Lake Baikal is to be very large. New houses are opening up for business and the old firms are enlarging their plants. Farmers are having their orders filled as fast as the machines can be put together, and the demand is constantly increasing.

* For further discussion of the West Indian eruptions see SCIENTIFIC AMERICAN for August 16, 1902, and SCIENTIFIC AMERICAN SUPPLEMENT for September 13, 1902, and July 15, 1903.

THE IMPROVED LONGUEMARE CARBURETER.

By the PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

THE Longuemare carbureter is one of the most successful of the European types and is largely used for stationary motors and automobiles. The most improved form is shown in the sectional view, Fig. 1. It consists of a float-feed chamber connected with an atomizing cylinder. The gasoline tank is connected at *I* by a conical joint. The liquid enters through a filter, *H*, consisting of a wire gauze partition which stops the impurities and allows them to be taken out from below at *J*. When the constant-level chamber, *A*, is empty, the float, *B*, rests upon the extremities of the counterweight-levers, *GG*, which turn on their pivots, raising the collar, *F*, and also the needle-valve to which it is attached. A small orifice is thus opened, and the liquid enters the float-chamber. When a sufficient quantity comes in, the float, *B*, is raised in turn and ceases to rest upon the levers. The rod of the needle-valve, acting by its own weight and that of the collar, *F*, counterbalances the levers, *GG*, and, falling, hermetically closes the entrance orifice of the liquid. From the float chamber the gasoline enters the chamber, *M*, through a small tube, and thence reaches the upper part, M^1. The weight of the float and the proportions of the apparatus are regulated so that the level of the liquid is established just below the upper part of the chamber, M^1. When the gasoline is used up and the level falls in *M*, it also falls in *A*, and the float bears again upon the levers, causing the needle-valve to open and to admit a fresh supply. The chamber, *M*, is closed at its upper part by an atomizer, *L*, in the form of a truncated cone, the surface of which contains grooves which form the jets of liquid; these grooves are fine enough to produce an atomizing effect, and the liquid comes out in a spray. Above the atomizer is fixed a regulating device, which is held against a circular shoulder by a spring passing around the upper rod. The rod carries first a perforated disk, *o*, and below it a piece carrying a set of openings which, upon the rotation of the device from the outside by the handle, *S*, uncover more or less the openings, *PP*, for the air admission. The device also carries the throttling cylinder, *N*, which surrounds the atomizer; its diameter is variable according to the needs of the carbureter. A second handle, *T*, operates a revolving cylinder (shown in the dotted lines) which bears against the outlet orifice, *Y*, and can partially obstruct it. The position of each of the handles is marked upon the cover, *Co*, by the letters, *O* and *F*.

To operate the carbureter the handle, *S*, of the air supply is placed on the letter, *F* (closed), and the handle, *T*, at the point, *O* (open). When the motor operates, the air arrives abruptly through *X* to fill the vacuum created, and can only pass in the annular space between *N* and *L*; it thus acquires a great speed, which causes a spray of liquid to leave the atomizer through the grooves. The air and the spray of gasoline are intimately mingled, and the mixture is completed on passing through the orifices of the perforated disk, *o*. The gas passes from the chamber, *R*, through *Y* to the motor. When in operation, the best mixture is found by turning the handle, *S*. The quantity of gas to the motor is regulated by *T*, giving a greater or less power. The small contact piece, *E*, serves to indicate the position of the float to assure that it is working properly, and the entry of gasoline can be operated independently by pushing down the float. At *vv* is a heating jacket which is traversed by the hot gases of the exhaust, which enter by the tube, *U*. These carbureters are made in different sizes and forms for automobiles and motorcycles.

The method of mounting upon a motorcycle is shown in Fig. 2, where *b* is the supporting collar, fastened at *g*, *Y* the gas supply, and *X* the air inlet. The tube, *a*, leads from the gasoline tank to the float chamber, *A*. To the muffler is attached the tube, *c*, which leads through *c* to the heating jacket *U*, which has the outlet tube, *f*. The rods, *m* and *n*, control the carbureter.

Another form is adapted to use either gasoline or alcohol carbureted at 50 or 75 per cent without changing the apparatus. The regulation is secured once for all by means of the needle valve which is operated from the outside by a thumbscrew. This type is made either singly or with two atomizing chambers, the latter disposition being used with four-cylinder motors, so as to have but one float-chamber and also to regulate the two carbureters with the same levers. Simplified forms of the Longuemare carbureter have the following features: In one form the atomizer is surrounded by a conical piece against which the liquid stream strikes on leaving the atomizer, causing it to be well mixed with the air which enters below. The resulting mixture passes up and can be further mixed with air through a set of openings which are controlled by a revolving collar. The float-feed is the same as before. A still further simplified type works without a float feed. In its place there is mounted in the center of the spraying cone, a needle-valve which admits the gasoline from the lower tube to a set of horizontal orifices which communicate with the holes of the spraying cone. This needle-valve also carries a conical cap perforated with holes and fitted over the spraying cone. A spring holds down the valve upon its seat. The air enters through the openings in the bottom, and the suction of the motor drawing it against the conical cap causes the cap to be slightly lifted, thus at the same time raising the needle-valve and allowing the spray to escape from the atomizer so that it strikes against the walls of the conical cap and is mixed with the incoming air. The mixture passes out through the holes in the cap and rises to a part having a series of holes communicating with the outer air; the holes can be partly closed by a revolving collar, which is worked by a lever. The action is regulated so that the motor draws in the right quantity of gasoline at each aspiration, and thus a float-feed is dispensed with and the feed pipe of the carbureter is connected directly to the gasoline tank. A heating jacket is also provided.

Still another form of carbureter is designed to work with pure alcohol, and can be also used for gasoline or carbureted alcohol; in the latter case the apparatus can be started when cold as usual, but for pure alcohol it is found best to heat up the carbureter before starting. To do this, several small holes in the outer jacket are uncovered by a sliding collar, and a bunch of asbestos saturated with alcohol is ignited below the carbureter. The hot gases from the flame enter the jacket through holes in the bottom and escape through those in the side, after giving up most of their heat to the walls of the chamber. This heating occupies about two minutes, after which the holes on the side of the jacket are closed, and the motor is started. A feed-nozzle needle valve is set once for all according to the quality of the fuel, and needs to be opened more for alcohol than for gasoline. The heating jacket is supplemented by heating wings of metal inside the chamber above the atomizer, which wings are heated by conduction from the exhaust jacket through which the hot exhaust gases pass. This arrangement is necessary, as alcohol mixture needs to be well heated before going to the motor.

One of our illustrations shows the way in which the atomizing nozzles are all tested before being used in carbureters. Water is sprayed through them under pressure equivalent to the suction obtained in the motors for which they are intended. So well do these atomizers work, and so well designed and constructed are the complete carbureters, that ordinary kerosene has been used in one of them in the French Automobile Club's recent consumption tests, and the motor was found to work well and develop much more power with a less amount of fuel than when gasoline or alcohol was used. A full account of this interesting test was published in SUPPLEMENT No. 1448.

TESTING ATOMIZERS OF LONGUEMARE CARBURETERS.

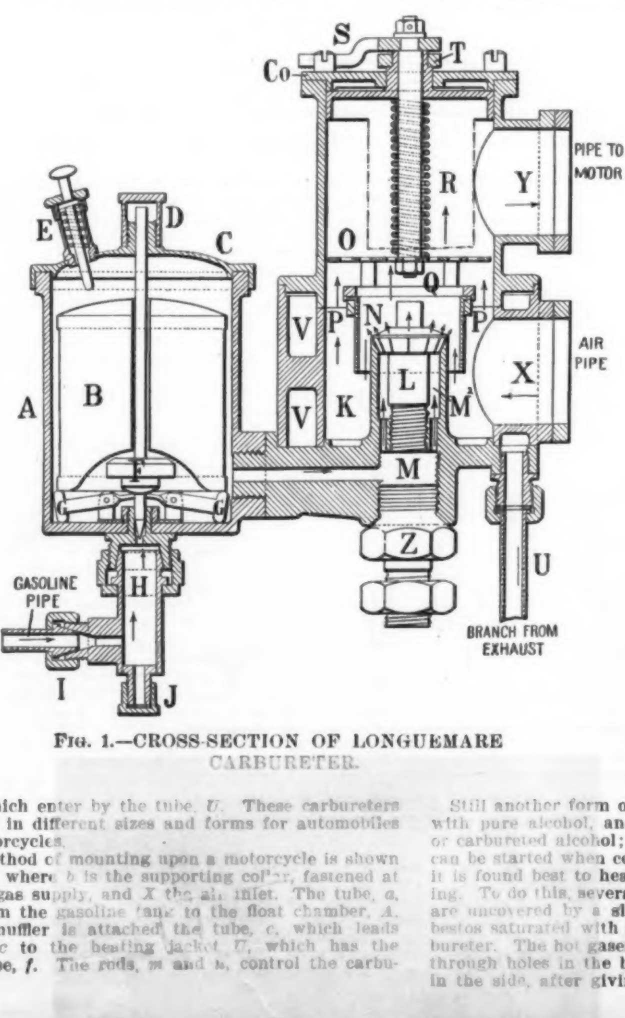


FIG. 1.—CROSS-SECTION OF LONGUEMARE CARBURETER.

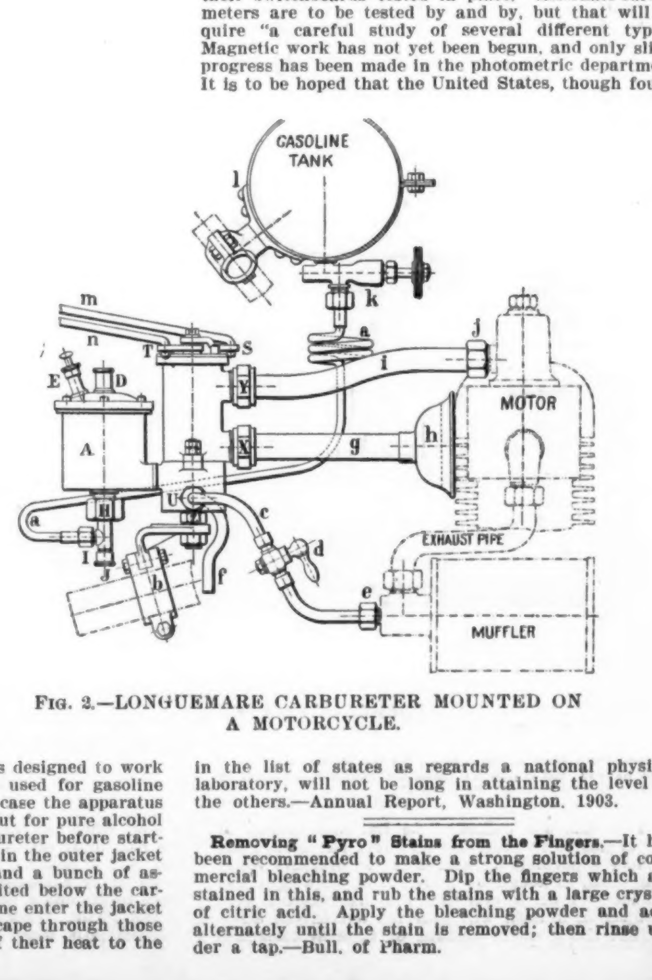


FIG. 2.—LONGUEMARE CARBURETER MOUNTED ON A MOTORCYCLE.

AMERICAN BUREAU OF STANDARDS.—The National Bureau of Standards was formed by act of Congress of May 3, 1901, out of the Office of Standard Weights and Measures, and established in Washington on July 1 of the same year. The first annual report gives an account of the work done up to June 30, 1902, and shows that much of it is on the lines of the Reichsanstalt and Kew work. The director hopes shortly to be able to certify instruments for the measurement of temperature from —190 deg. C. to 1,500 deg. C., and so save the American manufacturers the humiliation of being "compelled to go abroad for reliable standards which are certified by foreign testing bureaus." He has a plan for a portable apparatus to permit electric light and power companies to have their switchboards tested in place. Alternate-current meters are to be tested by and by, but that will require "a careful study of several different types." Magnetic work has not yet been begun, and only slight progress has been made in the photometric department. It is to be hoped that the United States, though fourth in the list of states as regards a national physical laboratory, will not be long in attaining the level of the others.—Annual Report, Washington, 1903.

Removing "Pyro" Stains from the Fingers.—It has been recommended to make a strong solution of commercial bleaching powder. Dip the fingers which are stained in this, and rub the stains with a large crystal of citric acid. Apply the bleaching powder and acid alternately until the stain is removed; then rinse under a tap.—Bull. of Pharm.

A NEW PROJECTION APPARATUS FOR SCIENTIFIC WORK.

By L. B. ELLIOTT.

THROUGH the courtesy of the Bausch & Lomb Optical Company I have the pleasure of describing for your readers a new model of projection apparatus, designed especially for scientific work. The original model was described by me before the American Microscopical Society at Pittsburg in July, 1902, and the apparatus has, since that time, been improved and an attachment for vertical projection added.

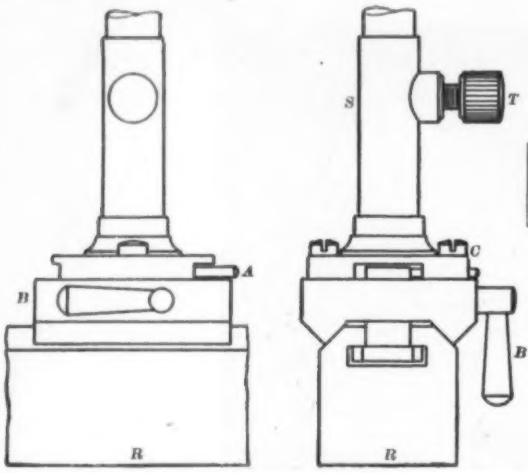


FIG. 1.—DETAIL OF CONSTRUCTION OF BASE BLOCKS FOR APPARATUS SUPPORTS SHOWING THE TWO INCLINED PLANES ON WHICH THE BLOCKS REST.

S piece in T slot which, when rotated 90° by the lever *A*, permits the removal of the base block from the rod; also the clamping lever *B*, which clamps the base block rigidly on the rod *R*.

In the construction of this apparatus an effort has been made to secure the utmost rigidity of the optical parts, the greatest possible facility in changing their position, without changing their relation to the optical center of the apparatus, and to permit the removal and replacement of any part without disturbing any other part, at the same time always insuring perfect centering, no matter how many times removed and returned to the apparatus.

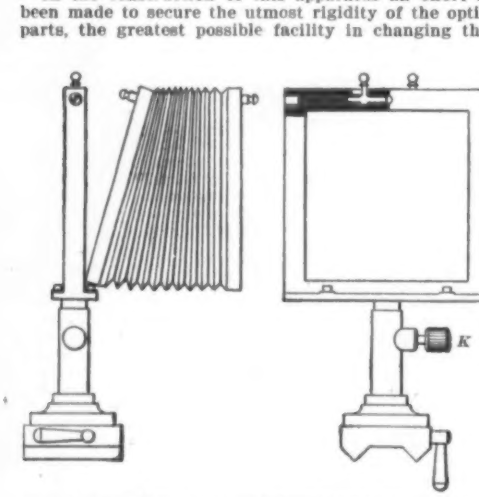


FIG. 2.—DETAIL OF CONSTRUCTION OF SUPPORTS FOR BELLOWS, OBJECT, LENS, BOARD, SLIDE CARRIER, ETC.

In the projection apparatus heretofore in general use, portability has seemed to be the main feature which has been kept in view, and rigidity, convenience in working and optical efficiency have been subordinated to this one demand. In the construction of the apparatus to be described no effort has been made to produce a portable apparatus in the ordinary sense of that term, although no undue bulk or weight has been added. I think everyone who has worked with the projection lantern will bear me out in the statement that the greatest amount of time is consumed and the greatest amount of trouble is caused to the operator and the lecturer through the inability to rapidly center the optical parts of the apparatus and to retain the parts in the center, once they have been adjusted. In this apparatus the fundamental principle of a fixed optical center for all parts of the apparatus has been adopted, the only adjustment required being that to bring the source of light into the optical axis, and to separate it the proper distance from the first element, namely, the rear lens of the condensing system. To this end all the optical parts and their connections are mounted upon vertical pillars attached to heavy steel blocks, which, in turn, are mounted upon a steel bar, rectangular in section, having two inclined surfaces accurately planed on its upper side, the whole contrivance resembling a fine lathe bed in rigidity and accuracy of centering. A T slot is milled in the upper portion of the rod from one end to the other, and in this a T piece attached to a vertical axis passing through the block and carrying the optical parts, is placed. The T piece may be rotated through 90 deg. by means of the lever *A*, Fig. 1, placing its long axis parallel with the axis of the T slot, when the whole block may be lifted off from the bar, or if removed may be replaced upon the bar and held in position by releasing the lever *A*, which is actuated by a spring, causing the long axis of the T piece to assume a position at right angles to the axis of the T slot. This lever, being actuated by a spring, automatically locks the block on the rod, preventing accidental overturning during the adjustment. The block, with whatever optical apparatus it may carry, now rests upon the two inclined surfaces of the bar, and may be slid along its length, permitting whatever adjustment is required, and when in proper position the lever *B* is depressed, locking the whole rigidly upon the bar by means of a cam which draws the T piece firmly against the top of the T slot. It will thus be seen that any part of the optical equipment can be removed from the apparatus, or replaced, by releasing the T piece through the operation of the lever *B*, and rotating the lever *A* through 90 deg., and that each element will always return exactly in the optical axis, since its support rests only on the two inclined surfaces of the rod *R*, and must in every case find the true center through the clamping action of the cam lever *B*. The rigidity of the steel bar *R* and the heavy construction of the base blocks and vertical supports of the optical part retain the alignment and centering. Adjustment is made for the original centering of the optical parts in the vertical plane by mounting them on rods which slide in the sleeve tube *S*, and when centering has been accomplished further motion is prevented by the thumb nut *T*, which is clamped tightly, and which should, therefore, never be touched unless the part is decentered through some accident. In order to make all parts convenient for manipulation and interchangeable for different classes of work, the bellows, lens board, slide carrier, etc., are attached to rectangular metal frames by

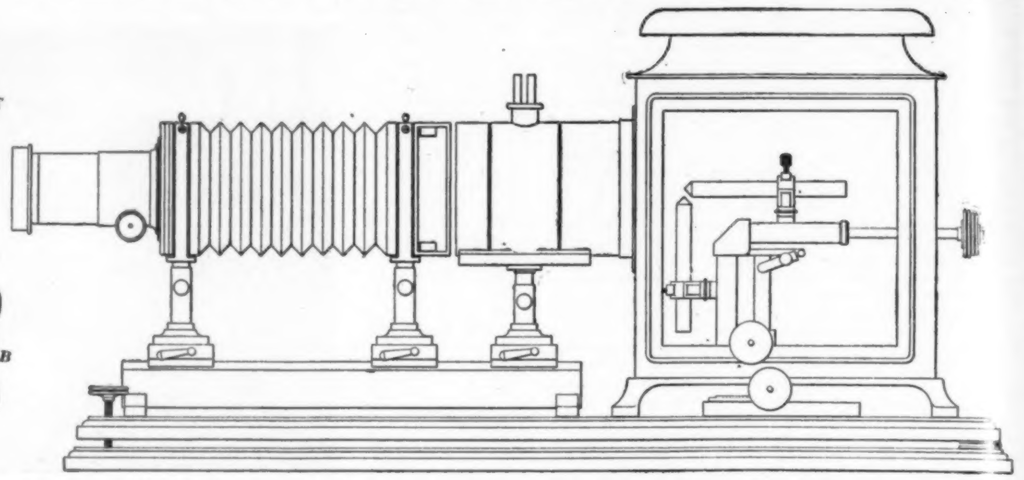


FIG. 4.—COMPLETE PROJECTION APPARATUS WITH HAND FEED LAMP AND PROJECTION LENS.

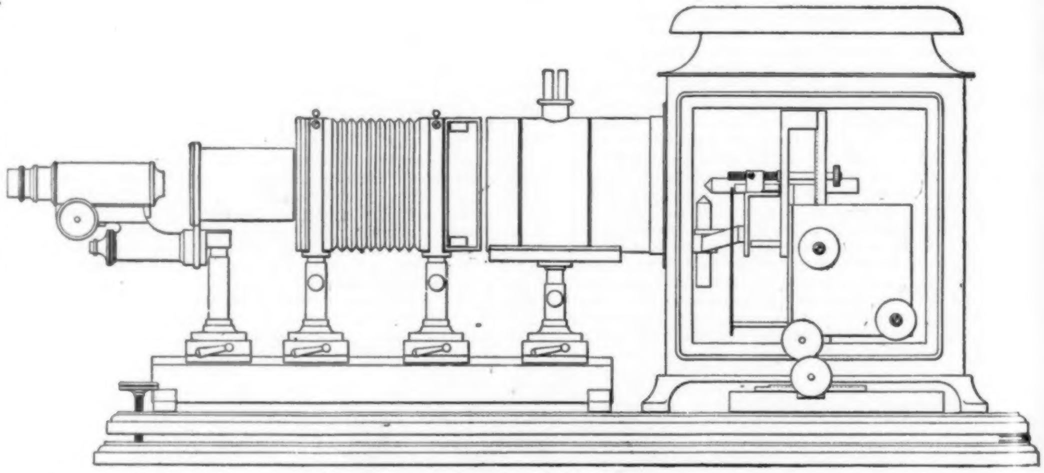


FIG. 5.—COMPLETE PROJECTION APPARATUS WITH MICROSCOPE AUTOMATIC ARC LAMP.

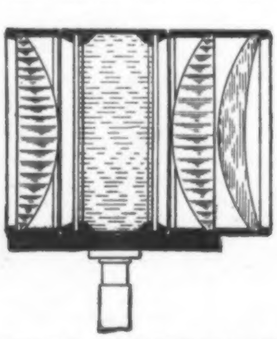


FIG. 3.—SECTION OF CONDENSER AND WATER CELL.

The condenser is a triple system between the two anterior elements of which the water cell is placed, securing the maximum absorption of heat rays with the minimum loss of light.

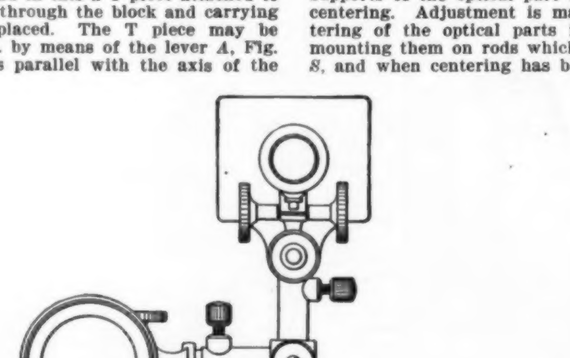


FIG. 6.—END VIEW OF COMBINED SLIDE AND MICROSCOPE OBJECT PROJECTOR.

two pins which slip into corresponding holes in the lower portion of the accessories, and by means of a spring catch with corresponding post in the upper side, thus by simple release of the knob *K*, Fig. 2, any of these parts can be instantly detached from their supports.

The condenser system for collecting the light and focusing it upon the object has received special attention, and a new condenser system devised, consisting of a meniscus convex lens which is placed next to the radiant, its concave surface facing the light. By this means a greater number of rays are collected and passed forward than in the case of condensers having a plano convex lens next to the light, and a flatter field, with the least chromatic aberration, is also secured. In combination with this meniscus convex lens are two plano convex condensing lenses with their convex surfaces facing and separated by a considerable distance. This is made possible through the use of the meniscus convex lens in the rear of the combination, and its object is to allow the placing of a water cell for absorbing heat rays between these two lenses, as, in this position, the light rays pass through nearly parallel, producing no distortion of the field and practically no loss of light through reflection from its surfaces. The water cell is composed of ground and polished glass sides mounted in a metal ring rendered water-tight by a rubber packing ring held in position by a screw ring on either side. These rings are removed when desired in order to clean the glass plates by means of a key, which renders their removal a very easy matter, thus allowing the cell to be kept always in good condition. The cell is kept in a vertical position when placed upon the table by means of two small metal feet which bear upon the table, and is filled through a circular aperture at the top into which two tubes are screwed, allowing for expansion of the fluid as it becomes warm, and also permitting the attachment of two rubber tubes so that a stream of cold water can be carried through the cell when projecting living forms, if desired. In order, however, to obviate the necessity of this procedure, for ordinary work, two water cells are furnished, and when one becomes warm it is only necessary to lift it out and set another in its place. Fig. 3 shows the construction of the condenser system and water cell in detail. Fig. 4 shows the parts assembled for the projection of lantern slides. The steel bar carrying the optical parts is mounted upon a base-board which is hinged to a wooden support at the rear end, and provided with elevating screws in front, so that the circle of light may be centered upon the screen with the greatest facility. The projection lens is carried upon the first support, to the front of the iron frame of which it is attached by the catch and pins before described. The bellows connects the lens with the support carrying the object carrier to prevent the escape of light into the room, and to the rear of the object carrier is found the condenser system with water cell. This water cell is a very great advantage even in ordinary projection work, owing to its absorbing a large part of the heat, and thus preventing the cracking of valuable slides, which occurs continually unless some such precaution is used. At the rear of the condenser system we find the lamp hood, of Russia iron, with door at the side and rear, open space at the bottom and hood at the top, by which ventilation is secured to prevent heating.

The illuminant may be either acetylene, oxy-hydrogen, lime light, or electric arc. The two former lights have not yet received much consideration, but a very convenient hand feed electric arc lamp has been devised. This lamp consists of a vertical support on which two arms at right angles are carried, the vertical arm carrying the vertical carbon, and horizontal arm carrying the horizontal carbon in the optical axis. Each carbon carrier is moved by a quick acting screw, the horizontal screw being actuated by a non-conducting milled head projecting through an opening in the rear door of the lamp-hood, thus being operated from the outside when the door is closed. The vertical carbon is actuated by a similar milled head slightly smaller in size immediately back of the milled head actuating the horizontal carbon, and connecting with the vertical carbon by means of a horizontal shaft which traverses the length of the shaft operating the horizontal carbon and connecting with the vertical quick acting screw by means of a miter gear. Thus both carbons can be moved simultaneously by placing the fingers upon the two milled heads; or each carbon can be moved independently by actuating its respective milled head, at the rear, the condition of the arc being observed through a dark-glass window in the side door. Vertical motion of the whole lamp is accomplished by means of a non-conducting milled head placed beneath the vertical carbon, and easily accessible, lateral motion being effected by another milled head in close proximity to that by which the vertical motion is secured The whole lamp is carried on a slide piece by which it can be moved backward and forward in the optical axis. A thumb-nut is provided for holding it rigidly in position when the desired focal point has been secured; thus with projection lenses of different foci, or for altering the focal point of the condensing lenses in various physical experiments, it is desirable to alter the distance of the arc from the rear condensing lens. This is very easily accomplished without decentering the arc, by this means, and it is a very quick and valuable method of adjusting the illumination. The placing of the carbons at an angle of 90 deg. to each other with the horizontal carbon in the optical axis, not only throws a greater volume of light from the crater of the positive carbon through the condensing lenses, but retains the glowing crater always exactly in the optical axis. No matter how irregularly the two carbons may burn, so long as the arc passes between them, the point of greatest intensity for light radiation will be in the optical axis. Any desired current can be used with a hand-feed lamp of this character, as there are no coils or magnets connected with it.

An automatic electric arc light is also in process of construction in which the carbons are placed at an angle of 90 degs. to each other, the horizontal carbon being placed in the optical axis. Experimental tests with this lamp so far conducted show that it will burn without attention for at least three hours, and that, its period of regulation being very short, the variations in potential in the arc are also very slight, hence the intensity of the arc remains practically unaltered, and the flickering, hissing and other irregularities observed in lamps in which a considerable length of time elapses between the movements of the carbons seem to be almost entirely absent. This lamp is arranged to adjust vertically, laterally, and horizontally, just as the hand-feed lamp does, and while it is constructed to operate on 110-volt direct current and gives good results with 10 or 12 amperes, the automatic feed may be entirely cut out and the lamp operated as a hand-feed lamp with independent movement of each carbon, on either direct or individual current, and with any desired voltage.

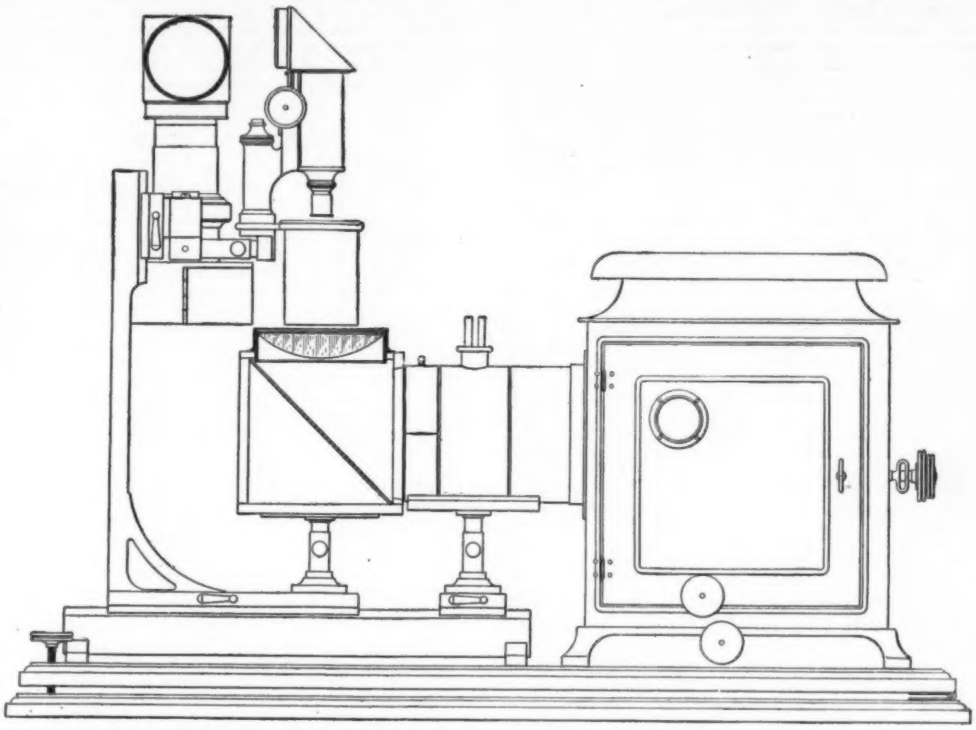


FIG. 7.—VERTICAL ATTACHMENT FOR COMPLETE PROJECTION APPARATUS.

The crucial test of the whole apparatus, however, lies in the substitution of the projection microscope, as in Fig. 5, for the ordinary projection lens. In this case, where microscope objectives are used, in which the front lenses are from 1 to 2 or 3 millimeters only in diameter, the whole optical apparatus must be absolutely centered and the radiant placed exactly in the optical axis in order to obtain good results. The construction proves itself accurate to such an extent that it has been possible to build upon one of the supporting bases a double projection apparatus, consisting of two arms at right angles attached to a common center, one bearing the ordinary projection lens for projecting lantern slides, and the other a projection microscope, the construction being shown in Fig. 6. It will thus be seen that either the projection microscope or projection lens can be swung into the optical axis and the accuracy of the centering and stability of the whole is such that when the projection lens is focused upon an object in the slide carrier, and the projection microscope is focused upon an object on the microscope stage, the light being suitably arranged for either, the other may be swung into position, and its image instantly projected upon the screen; thus, if the demonstrator is desirous of showing, for example, an illustration of hydra, representing it in its living form, with its surroundings, he can do so by means of a lantern slide and instantly substitute upon the screen for this picture the image of a cross section of the hydra itself by means of the projection microscope. Any part of a lecture can be illustrated with lantern slides and microscopic sections can be interspersed between them. The value of this attachment permitting the use of the projection microscope or the ordinary projection lens at will, will be more appreciated when one has an opportunity to run through a long series of papers on different subjects, such as are found on the programmes of society meetings or in the lecture room in a large educational institution during a day's work. The projection microscope used with this apparatus is of very simple construction, being simply a microscope fine adjustment and coarse adjustment with body tube and stage, as in an ordinary microscope, but instead of the pillar and base a special arm which adapts it to one of the supporting blocks identical with those which carry the other optical parts. The stage is provided with a sub-stage actuated by quick-acting screw, in which condensing lenses of various foci can be used for different power objectives. The microscope lenses employed for projection work with this apparatus consist of microscope objectives having a somewhat less numerical aperture than those usually employed for visual purposes, thus securing greater depth of focus or penetration, in-

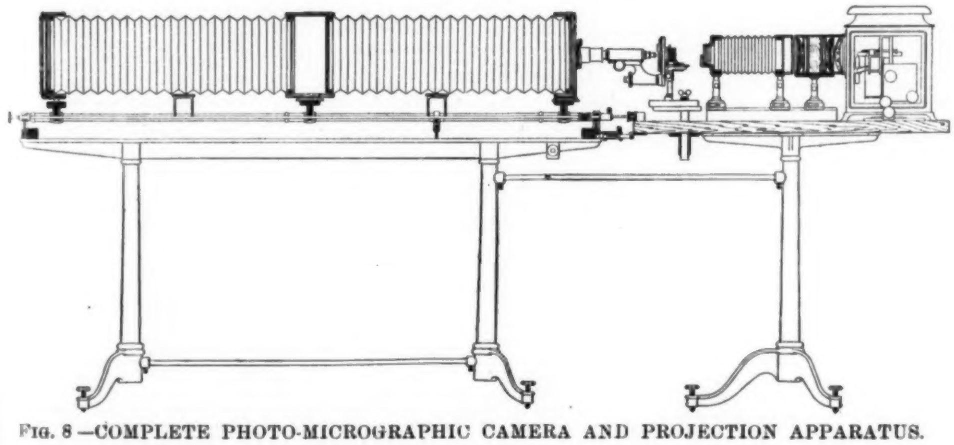


FIG. 8.—COMPLETE PHOTO-MICROGRAPHIC CAMERA AND PROJECTION APPARATUS.

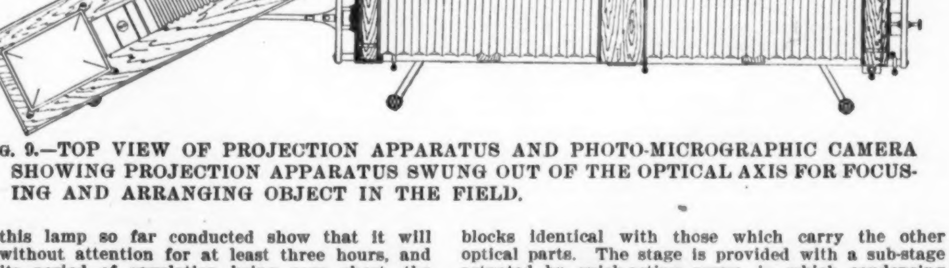


FIG. 9.—TOP VIEW OF PROJECTION APPARATUS AND PHOTO-MICROGRAPHIC CAMERA SHOWING PROJECTION APPARATUS SWUNG OUT OF THE OPTICAL AXIS FOR FOCUSING AND ARRANGING OBJECT IN THE FIELD.

creasing their value for thick objects, and especially corrected to eliminate spherical aberration and color, without special regard to chemical focus, as this is of no consequence in a projection lens. The mounts are perfectly straight and provided with a sliding hood carrying a diaphragm. The size of the aperture in this diaphragm is regulated to cut off the edge of the field, so that a perfectly sharp and well defined circle appears on the screen, as (without this diaphragm) the image would gradually fade off, giving an unpleasant effect. When, however, it is desired to increase the size of field for regional demonstrations, etc., it is only necessary to slip the hood off from the objective and replace it again when needed. Powers of from three inches down to one-half inch are used with great facility on ordinary screens, at the ordinary distance at which ordinary projection lenses are used, giving ample illumination for observation, even in the rear of a good-sized room, and with circles up to eight or nine feet in diameter. When, however, it is desired to use higher powers, the best results are obtained by using smaller circles, perfectly opaque and perfectly flat, white screens, or better still, semi-transparent screens for the very highest powers, and placing the lantern facing the audience, projecting the image so that it will be viewed through the screen. In this way it has been possible to show bacteria with a 1-12-inch oil immersion lens to audiences of considerable size.

The apparatus, as thus far described, is intended for projection of such objects as can be stood upon edge and projected in the ordinary manner, preferably permanent microscopical preparations and ordinary lantern slides. Where, however, it is desired to show living forms under the microscope, or under the ordinary projection lens in fluid, etc., an apparatus for diverting the beam from the condensing lenses to a vertical path, and then bringing it again to the horizontal axis, is required. For this purpose a horizontal attachment to the projection apparatus has been devised, a diagram of which is shown in Fig. 7. This attachment is intended for use with either the projection lens or projection microscope. It consists of a large plane mirror with a perfect surface set at an angle of 45 deg., mounted in a light tight box and carried on a rectangular arm. This is attached to the base bar of the projection apparatus by a T piece, as the other attachments are. The vertical arm for this attachment is arranged to hold the microscope and projection lens used for regular projection, and, when placed upon the arm, the microscope and projection lens come into the optical axis of the beam of light projected upward from the mirror. For use with the projection lens, the front plano convex condensing lens is lifted out of the condenser system, it being mounted in a ring with knob for this purpose, and placed with its plane surface uppermost in the cell above the inclined mirror. A plane plate of glass mounted in a suitable ring is then placed over the condensing lens to protect it, and the objects to be projected are placed upon this glass plate. The projection lens is focused upon it, and upon the hood of the projection lens a 45 deg. prism is placed which diverts the vertical beam to a horizontal path, throwing the magnified image upon the screen. A small percentage of light is lost in these reflections, but where the apparatus is perfectly centered, and the prism and mirror surfaces are very accurately made, the percentage is so small that with the arc light no difficulty is experienced in projecting lantern slides and all ordinary translucent objects at ordinary distances, and securing circles of the same size as with the ordinary projection lens. At about twenty feet distance, with the one-fourth projection lens, magnifications of about 30 diameters are had, and an object over four inches in diameter can be shown, so that one can take a four-inch Petri dish for example, filled with water, and place in it a series of frog larvæ from the egg up to forms with legs and demonstrate the whole series at one operation. The formation of crystals, the observation of dissections, and hundreds of other uses will suggest themselves for an apparatus of this kind. When the projection microscope is swung into position, the plano convex condensing lens is returned to the front of the condenser system, and its protecting plate is replaced by a metal diaphragm having a circular opening of the proper size to admit the beam of light from the mirror into the condensing system of the microscope. A 45 deg. prism placed upon the top of the microscope tube serves the purpose of reflecting the vertical beam to a horizontal path. With the projection microscope the illumination is sufficient for use with powers up to and including one-half inch with ordinary screens at the same distance that the projection lens is ordinarily used, and with undiminished circles of light.

The great advantage of the horizontal position for preparations of living forms such as Paramœcium, Gammarus, Entomostraca, Amœba, Vorticella, and other infusorial forms, as well as any other microscopical thing in fluid which it is desired to show, as, for example, urinary deposits, crystals, etc., is apparent.

The optical bench, as above described, is mounted upon a three-legged iron support so that it may be rotated completely around, and this mounting can be used for photomicrography as well as for projection work, being in this case attached to the complete photomicrographic camera as shown in Fig. 8, the microscope being swung out of the optical axis when it is desired to arrange the object in the field and for preliminary focusing, as shown in Fig. 9. This construction can be taken advantage of in the lecture room by having the photographic dark-room situated at the rear of the lecture room provided with a window opening onto the lecture room. The camera and optical bench can be lined up at the side of the dark-room next to the lecture room and the whole apparatus used for photomicrography when desired. When the optical bench only is desired for projection, the window can be opened, the optical bench turned through 90 deg. so as to project its image upon the screen, and both vertical and horizontal attachments can be used without difficulty in this manner. This projection apparatus can also be used to great advantage for making bromide enlargements, both from lantern slides and from microscopic objects to be used as charts. Any points to be emphasized can be worked up on such enlargements with crayon or pencil after the enlargements have been made, and any portions can be colored with anilin or water colors. This is a field of work which such a projection apparatus will greatly facilitate, and one which has as yet been very little developed. It is believed that this construction will lend itself particularly well to physical and chemical demonstration work, and the special accessories for these uses which are now in process of development will form the subject of another paper.—Journal of Applied Microscopy and Laboratory Methods.

ELECTRICAL NOTES.

In connection with the use of storage batteries in sub-stations, the results of an efficiency test on the complete transmission system of a typical American interurban railway system, in which eight sub-stations, at distances of 11 miles to 33 miles from the main generating station, are fed by a 16,000-volt transmission system, are interesting. On a daily load of about 25,000 kilowatt-hours the net efficiency of the transmission, reckoned from the low-tension bus bars in the generating station to the direct-current bus bars of the rotaries, averaged 73.5 per cent. Add to this extra amount of power the extra charges for interest, maintenance, and depreciation of the transmission plant, the cost of 1 kilowatt-hour, delivered to the line via the sub-stations, is more than double the cost of the kilowatt-hour delivered to the bus bars of the generating station.

It is stated that M. Maneuvrier, assistant director of the Laboratory of Researches of the Paris Faculty of Sciences, has just discovered an infallible method of ascertaining by the use of the telephone how much a given quantity of wine has been watered. The principle on which the invention rests is the variable conductivity of different liquids. The originality of M. Maneuvrier's ingenious application is his use of the telephone to determine to what degree the liquid under observation is a conductor.

The apparatus works as follows: Two vessels, one containing wine known to be pure, the other the same quantity of the wine to be tested, are placed on an instrument outwardly resembling a pair of scales. The telephone is in contact with both liquids. If the sample of wine under observation is as pure as the standard used for comparison, no sound is heard; if, on the contrary, it contains water, the telltale telephone "speaks," and the greater the proportion of water the louder the instrument complains. A dial on which a number of figures are marked is connected with the telephone. To ascertain the proportion of water in the wine tested, the operator moves a hand on the dial until the telephone, which has been "speaking" all this time, relapses into silence. The hand has thus been brought to a certain figure on the dial. This number is then looked up in a chart, which the inventor has drawn up, and corresponding to it is found indicated the exact proportion of water contained in the quantity of wine.

M. Maneuvrier's remarkable invention can, he says, be easily applied to the testing of many other liquids and even solids, which may be adulterated by the addition of foreign matter possessing a conductivity different to that of the original substance.

In the Elektrotechn. Zeitschr. B. Monasch describes some experiments with currents varying from 0.02 to 0.068 ampere. Electrodes of lead, bismuth, and antimony are too easily volatilized to be of use. Practically all other substances can be used, and the author conducted his experiments with copper electrodes. After an arc of 0.068 ampere had passed for three hours between copper electrodes, 5 mm. in diameter, the change in the diameter was certainly less than 0.01 mm., and the surface was covered with a slight black film. Alternate current of 47 cycles was used, and the power consumed in the arc was measured by the electrostatic wattmeter described by Blondlot and Curie in the Journal de Physique, p. 80, 1889. In order to keep the conditions constant during the tests, the electrodes and their supports were placed on the receiver of an air pump and covered with a glass bell jar, having a volume of 0.003 cu. m., into which air could be drawn through wash-bottles, filled with sulphuric acid. Under these conditions, steady readings could be obtained within three minutes of starting the arc. A bell jar is necessary, otherwise the mere movements of the observer cause drafts, which make the arc unsteady. The author first examined the relation between the length of arc and watts consumed, both real and apparent, the current being maintained constant. This relation is graphically expressed by a straight line in all the cases examined. Calling the ratio of real watts to volt-amperes the apparent lag or the power-factor, with a current of 0.041 ampere the power-factor rises from a value of 0.58 with an arc 3 mm. long, to 0.63 with an arc of 10 mm., the copper electrodes having a diameter of 5 mm. The real watts in this case varied from 17 to 29. The next point investigated was the effect of the atmospheric pressure within the bell jar on the arc, and more particularly the effect produced by a partial vacuum. Although the pressure required to maintain a given arc in a vacuum is rather higher than that required at ordinary atmospheric pressure, the voltage does not pass steadily from the one value to the other, but falls and passes through a critical point. The author's investigations extended to a pressure of one-seventh of an atmosphere, below which point he was unable to get steady readings. Over this range he found that the voltage required to maintain an arc of given length decreased steadily. With arcs of from 3 to 8.7 mm., the voltage required with a mercury pressure of 100 mm. is about 40 or 50 per cent less than that required under ordinary atmospheric pressure. Three diagrams are given in the article. The first shows the relation of real and apparent watts to length of arc, the current being maintained constant; the second shows the relation between the voltage and the mercury pressure under partial vacuum for various lengths of the arc; and the third shows similarly the relation between real and apparent watts and the mercury pressure under the same conditions.

ENGINEERING NOTES.

A very important piece of drainage work has been carried out at Cannes in diverting the sewage water from the Chataignier stream which formerly discharged its contaminated waters into the sea on the east side of the new Albert Edward jetty, rendering the neighboring waters almost pestilential, and discoloring the beautiful stonework. This nuisance has now been suppressed, the Chataignier having been tapped, as it were, at a certain distance from the sea, and the drain carried to a point opposite the new jetty, thence straight along it, and, finally, into the sea.

The power plant of the forthcoming World's Fair, St. Louis, will contain among other items a 3,000-horsepower gas engine, the product of the Société Anonyme John Cockerill, Seraing, Belgium. The World's Fair power plant will embrace more than 40,000 horse power, and the installation will be wholly within the buildings comprising the machinery department of the Exhibition. The 3,000-horsepower gas engine has two cylinders, each having a diameter of 51 inches. The length of stroke is 55 inches, and the revolutions per minute when developing 3,000 horse power will be 85.

A 100-inch driving-wheel lathe capable of taking in wheels of 100 inches diameter, is one of the new machine tools installed at the shops of the Chicago, Milwaukee, and St. Paul Railway, at West Milwaukee, Wis. In a test made with a pair of 84-inch wheels, the tires were turned simultaneously, with an average depth of cut of 5-16 inch at each tool, and a feed of 3-16 inch. The cutting speed was 18½ feet per minute, and the work was done in 63 minutes. The average power required at the motor was 16½ horse power, increasing to 22½ horse power when hard spots were encountered by the tools. The lathe weighs about 56 tons, exclusive of its motor, and is driven by a 20-horsepower electric motor.

In a paper recently read before the Institution of Civil Engineers, Mr. Apjohn described his experience in excavating clay by means of hydraulic dredgers having rotary cutters fitted to the nozzles of the suction pipes. As the material was of silty character, it was believed that it would be readily broken up by the cutters, but this was not found to be the case. In the loamy soil first encountered the cutters answered well, but on arriving at the clay the blades became clogged, and the amount of clay in the water discharged was very small. After some experiments a new form of cutter was made with narrow spiral knives, but this device was not particularly successful. From the experience detailed in the paper we learn that, while the efficiency of the cutter depends upon the form of the blades, the angle at which they are set, and on their spacing, it is difficult to determine the best form for adoption without the aid of exhaustive experiments, such as have not been conducted up to the present time.

The Compagnie Intercommunale des Eaux of Brussels has adopted ferro-concrete pipes for some of its water mains laid since 1902. The length of the ferro-concrete mains laid so far is 2½ miles, and the diameters range from 23.6 inches up to 31.5 inches. The maximum head is 138 feet. For heads below 66 feet the pipes are built upon a skeleton of steel bars of double T-section. A number of these bars run lengthwise of the pipe, and round them is wrapped a spiral of similar steel bars, the spacing of which is varied with the head to be withstood. This steel skeleton is placed in a vertical mold, which is then filled with a quick-setting cement. Each length of pipe is 10 feet, and the joints between successive lengths are made by means of a ferro-concrete sleeve, made tight by cement mortar. For greater heads the basis of the pipe is a steel tube 1-25 inch thick, inside and outside of which is arranged a steel skeleton of double T-irons, such as already described. The whole is then cast with cement, as already explained.

The first of a series of special service inspection steamers for the use of the Egyptian government on the Nile has recently been built by the Thames Valley Launch Company, Limited. There will be altogether ten or twelve of these small screw steamers, and each will be in charge of an inspecting officer, for whom every comfort is provided on board in the way of sleeping and living accommodation. There is a comfortable cook's galley aft, with engineer's bunk and store-room abaft this. In the saloon there are two comfortable berths fitted with mosquito curtains, and there are copper gauze sliding frames to each window, as well as a glass pull-up sash and sliding jalousies outside. The saloon top forms a promenade deck with awning, and a companion ladder is fixed at either end. The steering is at the after end of this deck. The whole of the upper works, saloon, etc., are made to take down and pack inside the hull for shipment. The hull is built of steel, and the machinery is of the compound surface-condensing type, developing a speed of eight to nine miles per hour.

The Tasmanian government is doing its best to bring the qualities of the timbers of Tasmania to the notice of users of hard wood in Great Britain. A year since an official report on them was issued, and now the Agent-General sends us a supplementary pamphlet giving the opinions of several Tasmanian officials who have had to deal with the hard woods of the country for many years. The Engineer-in-Chief of the Department of Public Works says that native-grown "blue gum" and "stringy bark" have been used for general constructive works from the earliest times, and with satisfactory results. Railway sleepers of these woods last on the average about fifteen years, though the life of the wood is, of course, dependent in a great measure on the rainfall, which varies very considerably in different parts of the country. Other reports follow much in the same strain. All those who make the reports agree that the two varieties of hard woods mentioned are among the best in Tasmania; and some are of opinion that the "blue gum" has a longer life than "stringy bark." Both the woods have stood well as piles in tidal waters, for bridges and the like, and some of the piles are a hundred feet in length.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

German Meat Inspection.—The results of the German meat inspection law which went into effect on April 1 of this year are already quite noticeable in the figures of German meat imports.

In the two months of April and May, 1903, only 2,138 tons of fresh meat were imported into Germany, against 4,160 tons during the same period of 1902, and only 1,800 tons of simply prepared meat, against 4,852 tons in April and May, 1902. Sausages and canned meat are not included, as such imports of "prepared meats" have been prohibited since October, 1900.

As the new law applies to fatty substances for food purposes, imports of lard and artificial lard have also decreased from 17,141 tons in April and May, 1902, to 10,109 tons for the same months in 1903.

The fresh beef imports decreased from 2,150 tons to 1,192 tons; fresh pork, from 1,988 tons to 936 tons; pickled pork, etc., from 1,365 tons to 474 tons; hams and bacon, from 2,875 tons to 853 tons.

From the United States only 7.4 tons of ham were imported in April and May of this year, against 262 tons in the same period of 1902; of bacon, 507 tons against 1,749 tons.—Richard Guenther, Consul-General at Frankfort.

Statistics just issued concerning the importation of meat give the following facts:

The importation of prepared beef from the United States for the month of May, 1902, amounted to 466,600 pounds and for the month of May, 1903, to 99,600 pounds, a decrease of 367,000 pounds; as to prepared pork, the figures for May, 1902, show an importation of 800,400 pounds and for the same period of 1903 only 29,200 pounds, a decrease of 771,200 pounds. The importation of American hams has practically ceased; during May, 1902, 202,600 pounds were imported, while the statistics for May, 1903, show only 200 pounds.

Upon inquiry, I am informed that since this law went into effect (April to July 1) 768 pieces of bacon, sides, and hams were inspected here at Stettin and that not a single piece was rejected. The local market has shown but slight advance in the price of meats; but just as soon as the immense supplies that were "laid in" before this law went into effect are consumed and the drain on the home market commences, there will be a sharp advance.

It is believed that this act will undergo a modification in the near future.—John E. Kehl, Consul at Stettin.

EXPORTS OF AMERICAN MEATS TO GERMANY.

Quantities and values of American meats and meat products exported to Germany during the fiscal years 1893, 1896, and 1899-1902, compiled from the annual volume of the Bureau of Statistics showing the exports of domestic merchandise by articles and countries :

Quantities.

Article.	1893.	1896.	1899.	1900.	1901.	1902.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Beef:						
Canned	10,017,142	7,539,806	3,334,880	3,876,806	2,559,754	353,414
Salted and other cured	6,226,871	6,579,728	5,911,654	6,041,811	6,966,853	8,730,223
Tallow	6,034,293	6,983,531	16,895,589	10,802,572	10,321,084	5 358,659
Bacon	8,106,499	9,086,825	36,014,178	26,027,162	18,394,390	20,009,656
Hams	898,804	1,855,798	9,813,118	3,615,843	2,156,646	2,128,576
Pork, salted or pickled	709,900	1,261,000	15,515,225	11,062,825	9,830,425	8,671,775
Lard	70,170,320	121,893,903	229,230,175	195,595,578	182,389,879	173,517,891
Oleo, the oil, and oleomargarine	23,576,742	25,403,079	30,612,969	27,229,755	34,717,310	28,321,585
Total	125,740,571	180,603,670	347,327,788	284,252,352	267,336,341	247,091,779

Values.

Article.	1893.	1896.	1899.	1900.	1901.	1902.
Beef:						
Canned	$829,652	$616,540	$294,123	$361,319	$247,804	$35,318
Salted and other cured	334,983	376,158	319,506	344 846	397,395	570,922
Tallow	298,315	297,873	677,487	524,686	516,498	300.570
Bacon	678,237	603,022	2,520 225	1,887,810	1,386,055	1,675,155
Hams	91,805	176,443	903,010	345,540	218,758	219,826
Pork, salted or pickled	55,514	74,992	824,018	665,076	655,697	719,438
Lard	6,419,211	7,788,975	13,600,767	12,269,958	13,700,875	16,252,251
Oleo, the oil, and oleomargarine	2,371,399	1,773,454	2,080,029	2,141,867	2,647,875	2,597,581
Sausage casings	537,526	739,075	710,307	931,462	1,143,279	599,820
Total	$11,626,542	$12,446,532	$21,929,472	$19,472,564	$20,913,736	$22,970 881

Hungarian Attorneys and Notaries in the United States.—The Austro-Hungarian consul at Pittsburg, Pa., lately prepared a report which, when received by the Hungarian Minister of the Interior, caused the issuance of the following order (No. 61,221, 1902) by that official to county and city authorities:

"The Austro-Hungarian consul has called my attention to the procedure of numerous private agents calling themselves 'notaries public,' 'Hungarian or home attorneys,' 'law and collection office,' etc., who obtain powers of attorney from Hungarian residents to collect the amounts of death benefits due from certain societies or institutions to relatives of Hungarian citizens dying in the United States, or to collect damages obtained judicially, through the consulate at Pittsburg, from the employers responsible, and who then interfere in the action of the consulate by charging fees equal to a considerable amount of the sum collected, or in some cases by having themselves appointed useless trustees or guardians, since a benefit is not an inheritance from an estate, and so wasting the sums collected. The consul finds the cause of such interference in the delays, often extending to many months, of the Hungarian home authorities in sending the necessary powers of attorney to carry out the requests for releases from further demands, signed by the parties, or guardianship letters, of which delay the said agents take advantage to press their claims.

"The consul also calls attention to the abuse furthering the interests of the said agents by the viséing and sealing of the requested powers of attorney by the town councils, or the town or circuit clerks,* inasmuch as the agents prevent the consul from collecting the sums of damages or benefit sued for by him on the basis of such powers, by offering a compromise for a smaller sum and exhibiting the aforedescribed letters of trusteeship or guardianship, the consul having no time nor interest to carry through the validity of the powers of attorney so signed by a judicial suit. Such powers of attorney, he says, ought, according to the laws of most of the States of the Union, to be signed before a United States consul or a royal notary public of Hungary. In view of the foregoing, I charge you to carry out, without delay, the requests of the Austro-Hungarian consuls residing in the United States, and to warn the town councils (magistrates and clerks) to refrain from certifying the identity of the parties on powers of attorney, such certification having no force under the laws of most of the American States."—Frank Dyer Chester, Consul at Budapest.

* Called "notaries" in Germany and Hungary.

Development of Incomes in Germany.—The Deutsche Industrie Zeitung of July 17, 1903, says a remarkable addition was made to the economic literature of the empire by the publication of an essay by Dr. Nitschke, a Berlin statistician, on the development of people's incomes. The total income increase in the 900-mark ($214.20) grade in the income tables for the years 1892-1900 was 2,000,000 marks ($476,000). The income tax begins on incomes of 900 marks ($214.20). Most of the increase—fully seven-eighths thereof—falls to the prosperous period 1896-1900. The larger part of the total increase, viz., 1,080,000,000 marks ($257,040,000), includes the lowest grades in the tax-paying lists—those incomes of $214.20 to $714. Dr. Nitschke says:

"The claim that the greater part of the profit of the world's work falls to the share of the upper classes, in view of the facts given to us by statistics, is not true; nor is there anything in the claim that there is a constantly developing inequality of incomes, since during the years 1899-1900 750,000 taxpayers passed from below the $214.20 grade, set by the State as the point at which the payment of an income tax begins, to points beyond it. The claim that the middle classes are deteriorating is just as false. If an income of from 2,100 marks ($499.80) to 9,500 marks ($2,261) is taken as the basis of middle-class incomes, the census, or tax tables, will show that fully 750,000 taxpayers belong to this class. Of those paying on more than 9,500 marks ($2,261), there are 76,000, and more than 60,000 of these have incomes of from $2,261 to $7,259, while about 15,000 are taxed on incomes of more than $7,140. It is worth noting that the increase in the number of persons paying income taxes is much larger in the cities than in the country districts."

Machines and Implements in Russia.—The German consul at Rostoff reports, in the Nachrichten für Handel und Industrie, quite a steady demand in Russia for all kinds of tools, implements, machines, and other kinds of iron and hardware. He points, with some pride, to the part played by Germany in successfully supplying her share. Among the articles enumerated, surgical and optical instruments come first. He refers to American and English competition, particularly in the matter of electrical plants. He says the demand is great, since even the smallest cities are putting in electricity. They are enabled to do this because of cheap Russian petroleum. Guns and rifles of foreign make find ready sale and go in in huge quantities. Here again the competition is close. The United States and Great Britain send rifles, the latter sending the most expensive. Some German houses handle American and Belgian firearms. The demand for all kinds of agricultural implements, machines, etc., keeps ahead of the supply and is constantly increasing. Germany leads in selling plows, harrows, planting machines, cutting machines, and steam threshing machines. A falling off in the importation of china, crockery, and textiles is noted. The business year begins just after the harvest, with the advent of the commercial travelers, at which time orders are booked. The goods are delivered in February. Notes for six months are the usual form of payment. In some cases nine months' notes are given and taken. At times payment will be put off so that a year's credit is often required. Thus only companies having large capital can compete in a field of this kind. People of small means have hardly any chance in Russia's foreign trade.

The consul says the Russian prefers to buy from parties who deliver the goods free from duties, freight charges, etc., and who state the prices in rubles and the weights and measures in the Russian or metric system. Often the refusal to receive goods or to take them out of the custom house is due to unpleasantness connected therewith rather than to bad intentions. In conclusion he says: "It is best, therefore, in almost all cases of foreign sales, to keep a representative in the field."

In connection with the foregoing it is interesting to note that the United States is rapidly increasing its exports of high-grade tools and machinery to Russia. According to the Bureau of Statistics our exports of agricultural implements, typewriters, and other machines and implements to European Russia in 1892 amounted to $3,053,924.

The following table shows the value of certain high-grade American machinery sent to foreign countries. It is from tables prepared by the Bureau of Statistics.

EXPORTS OF HIGH-GRADE AMERICAN MACHINERY, 1892 TO 1902.

Article.	1892.	1895.	1898.	1900.	1902.
Electrical instruments	$1,388,117	$1,912,771	$2,770,808	$6,435,766	$5,389,476
Cash registers*	....	....	....	813,086	1,144,062
Electrical†	....	....	2,052,564	4,340,992	5,379,746
Metal working†	....	....	4,618,683	7,193,390	2,977,290
Sewing machines and parts of	3,133,992	2,260,139	3,136,364	4,541,774	4,022,697
Shoe machinery†	....	....	895,788	1,163,265	906,583
Steam engines:					
Fire	6,380	9 010	7,495	14,915	28,956
Locomotives	1,717,715	2,379,519	3,883,719	5,592,403	3,257,894
Typewriting machines and parts of	....	....	1,902,153	2,697,544	3,302,191
Total	6,246,204	6,561,439	19,267,571	32,793,145	26,468,894

* Not separately enumerated prior to 1900.

† Included in "all other machinery, etc.," prior to 1898.

Meat Exports of New Zealand in 1902.—The New Zealand Trade Review publishes the following figures covering the meat exports of 1902, with a table for comparison with 1901:

Description.	1902.		1901.	
Beef:				
Fresh	£256	$273	£165	$803
Frozen	370,691	1,803,967	258,951	1,260,185
Salted	9,708	47,243	8,463	41,185
Lambs, frozen	898,534	4,372,715	781,831	3,804,781
Mutton, frozen	1,183,072	5,757,419	1,027,679	5,001,200
Sheep	109,030	530,594	48,410	235,587
Pork:				
Frozen	9,729	47,346	6,535	31,803
Salted	129	628	1,762	8,574
Poultry, frozen	8,101	39,424	419	2,039
Veal, frozen	1,682	8,185	173	842
Other meat	8,318	40,478	1,881	9,153
Rabbits, frozen	116,996	569,361	114,552	557,467
Hares, frozen	1,888	9,187	3,261	15,870
Prepared and preserved meat	123,633	601,660	87,706	426,821
Meat extracts	17,95	87,358	847	4,122
Total, including notions not named	2,870,792	13,967,709	2,352,723	11,449,526

Japan vs. Ceylon Teas.—The Kobé Herald of June 19, 1903, says that since the opening of the tea season this year the market for common grades of tea has been very quiet and buyers have been few. This state of affairs is due to the fact that a considerable quantity of green tea in imitation of Japan tea has been shipped from Ceylon to the United States and Canada, and it is being sold at lower rates than the genuine Japan tea, with a view to ousting the latter from the market. The production of green tea in India last year was only 6,000,000 pounds; this year it is estimated at between 12,000,000 and 15,000,000 pounds, while it is intended to increase that quantity to 40,000,000 pounds, if possible. It is impossible for Japan tea to compete with Indian green tea in point of price, so that it is expected, says the Herald, that the commoner brands of Japan tea may be entirely deleted from the United States and Canadian markets in the course of three or four years.—Samuel S. Lyon, Consul at Kobé.

Concession to Extract Monazite Sand in Brazil.—The Board of Trade Journal, London, says.

"Referring to the announcement on page 588 of the Board of Trade Journal of June 25 last, notifying a call for tenders for the concession to extract monazite sand on the foreshore of the State of Espirito Santo, the Board of Trade are now in receipt, through the Foreign Office, of a copy of a dispatch from the British minister at Rio de Janeiro, inclosing a copy of the call for tenders as published in the Diario Official, together with precise translation of same."

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

SELECTED FORMULÆ.

Strawberry Essence.—G. Weinedel published a formula for this essence in the Pharmaceutische Zeitung some time ago: Fresh dry strawberries, 750 grammes, are pulped in a mortar, and then put into a retort with tokay, 200 grammes; cognac, 200 grammes. Then add vanilla 1.5 grammes; alcohol (90 per cent), 300 grammes; water, 500 grammes. This mixture is allowed to stand for an hour in the warm, and 1,000 grammes is then slowly distilled over and colored light red.

Glove Cleaners.—

1. Curd soap .... 1 ounce av.
   Water .... 4 fluid ounces
   Oil of lemon .... ½ fluid drachm
   French chalk .... a sufficient quantity

Shred the soap and melt it in the water by heat, add the oil of lemon, and make into a stiff paste with French chalk.

2. White soap .... 25 ounces
   Water .... 15 fluid ounces
   Solution of chlorinated soda .. 16 fluid ounces
   Ammonia water (10 per cent) .. 1 fluid ounce

Shred the soap and melt it in the water by heat, stirring well all the time; when lukewarm add the other liquids and mix thoroughly. Put the glove on the hand and apply the paste with a piece of flannel, rubbing the kid from wrist to finger tips.—Bulletin of Pharm.

Novelties in Meat Preservatives.—Dr. A. Racine contributes the following to the Zeitschrift für öfentlichen Chemie:

Pickling Salt.

Sodium nitrate	50 parts
Salicylic acid	5 parts
Boric acid	45 parts

Mix.

Preserving Salt.

Potassium nitrate	70 parts
Sodium bicarbonate	15 parts
Sodium chloride	15 parts

Mix.

Pickling Salt.

Potassium nitrate	50 parts
Sodium chloride	20 parts
Boric acid	20 parts
Sugar	10 parts

Mix.

Artificial Fruit Extracts.—Lemons being always procurable, it is best to make your extract with fresh lemons and etheric oil of lemon after the following excellent formula:

Fresh oil of lemon	64 parts
Lemon peel (outer rind) freshly grated	32 parts
Oil of lemon grass	1 part
Alcohol	500 parts

Mix, let macerate for 14 days, and filter.

Pineapple Essence.

Chloroform	1 part
Aldehyde	1 part
Butyric ether	5 parts
Amyl butyric ether	10 parts
Glycerin	3 parts
Alcohol, deodorized	100 parts

Mix all the other ingredients except the glycerin with the alcohol, shake together well, then add the glycerin and shake again. Filter, if necessary. Color with tincture of carmine.

Strawberry Essence.

Nitrous ether	1 part
Acetic ether	5 parts
Formic ether	1 part
Butyric ether	5 parts
Methyl salicylic ether	1 part
Amyl acetic ether	3 parts
Glycerin	2 parts
Alcohol, deodorized	100 parts

Mix and proceed as above. Color with tincture of carmine.

Raspberry Essence.

Butyric ether	6 parts
Acetic ether	4 parts
Nitrous ether	1 part
Glycerin	2 parts
Alcohol, deodorized	100 parts

Mix as before.

Essence of Orange.

Chloroform	2 parts
Aldehyde	2 parts
Acetic ether	5 parts
Formic ether	1 part
Butyric ether	1 part
Benzoic ether	1 part
Methyl salicylic ether	1 part
Amyl acetic ether	1 part
Oil of orange, fresh	10 parts
Tartaric acid, saturated solution	1 part
Glycerin	10 parts
Alcohol, deodorized	100 parts

Mix and proceed as above. Color with tincture of turmeric.

Peach Essence.

Aldehyde	2 parts
Acetic ether	5 parts
Formic ether	5 parts
Butyric ether	5 parts
Valerianic ether	5 parts
Oil of persicot	5 parts
Sebacic acid, saturated solution	1 part
Amyl alcohol	2 parts
Glycerin	5 parts
Alcohol, deodorized	100 parts

Mix and proceed as before. Color with tincture of saffron or turmeric. In coloring the essence of strawberry, raspberry, etc., the ammoniacal solution of carmine may be used alone, or it may be mixed with caramel.—Nat. Drug.

THE

Scientific American Supplement

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of The Supplement, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of The Supplement can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

Combined Rates.—One copy of Scientific American and one copy of Scientific American Supplement, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.